
حمل الآن
مجانا وحصريا
المراجعة رقم (1)
اختبار شهر مارس
ذاكرولى
RaNia SaYed
WWW.ZAKROLYUR.COM
حمل الان حصريا

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Lesson Two Depletion of natural resources

Depletion of natural resources is the process of consuming natural resources at a faster rate than their ability to regenerate.
This includes fossil fuels, minerals, water, soil, and biodiversity.
This process affects ecosystems, public health and economies significantly, for example the mining process.

Mining is the process of searching and extracting of important minerals and the resources from the surface of the earth
Mining can cause a great harm to the environment, when natural resources are excessively extracted

Mining or drilling wells have multiple physical effects such as:

1. The change in the distribution of energy in the environment.

When minerals are extracted from the ground, soil layers are removed, affecting the exchange of heat and moisture in the soil, air, surface water and ground water.
Moist soil has a **greater ability to retain heat** for **longer periods** compared to **dry** soil.
This leads to changes in the thermal balance in the region.


Impact of mining on soil.

2. Compression and erosion:

Mining involve applying significant pressure to rocks and soil. This can lead to:
a. Soil erosion and land degradation.
b. It creates voids in the rock, which lead to collapse of the ground.

3. Changing the structure of the land.

Mining and digging operations remove the upper layers of soil and rock, which leads to land erosion and destruction of natural habitats.
This erosion can cause landslides and deterioration in soil quality.

4. Leakage of chemical substances into the global.

This pollution can change the physical properties of water, such as the degree of acidity and mineral concentrations, affecting the aquatic environment.

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Ω Chemistry and Mining:

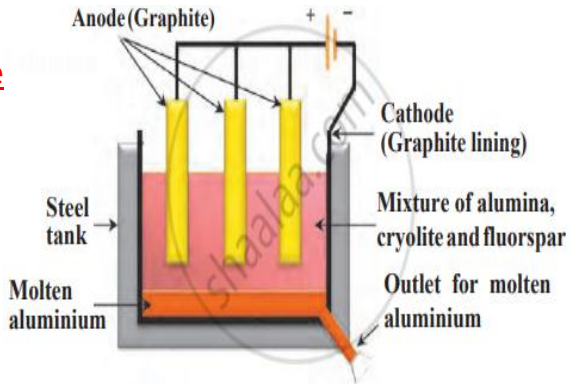
Chemistry is related to the processes of extraction, purification and use of minerals in various industries.

a. Chemical analysis of ore: before the mining process, the ore is analyzed using chemical techniques to determine the type of mineral and its quantity in the ore, which determines the feasibility of the mining process.

b. Extraction of minerals:

(1) Extraction of aluminum from bauxite ore using electrolysis

Aluminum is extracted from **bauxite ore** Al_2O_3 dissolved in **cryolite** Na_3AlF_6 by electrolysis process in the electrolytic cell shown in the figure



$$2\,Al_2O_3 \xrightarrow{\text{Electrolysis}} 4\,Al + 3O_2$$

(2) Extraction of gold using cyanide

Cyanide is used in gold extraction from its ores by dissolving it in an aqueous solution of sodium cyanide. Gold reacts with cyanide and oxygen to form a soluble compound of gold cyanide

$$4Au + 8NaCN + O_2 + 2H_2O \longrightarrow 4\,NaAu(CN)_2 + 4\,NaOH$$

- Gold is then separated from the solution using activated carbon or through other processes.

(3) Extraction of iron using hematite

a. Iron is extracted from hematite ore using coke, which reacts with a stream of oxygen, forming carbon dioxide

b. CO_2 is reduced from carbon to carbon monoxide gas that acts as a reducing substance to extract iron in a molten form.

$$C + O_2 \xrightarrow{\Delta} CO_2$$

$$CO_2 + C \xrightarrow{\Delta} 2CO$$

$$Fe_2O_3 + 3CO \xrightarrow{\Delta} 2Fe + 3CO_2$$

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c. Mineral purification

After some metals are extracted from their ores, the metals need purification processes, by electrolysis or by using chemical agents to purify the metals from impurities

☞Environment and Mining:

Chemistry plays an important role in reducing the environmental impact of mining through the development of techniques to treat the contaminated water and safe disposal of wastes.

Chemical waste disposal:

A process aimed at managing waste containing chemicals in a safe and effective manner to avoid environmental pollution and protect the health of human.
Given that they can be dangerous and toxic, their disposal requires careful procedures and strict regulatory standards.

Steps of chemical waste disposal:

A) Classification and separation:

It must be classified the wastes according to its type and severity.
There are flammable waste, toxic waste, radioactive waste, and reactive waste. Each type
of waste must be separated to ensure safe handling

B) Temporary storage:

-Chemical waste is stored in safe containers that are resistant to leakage and reaction.
-Clear warning labels should be placed on solutions indicating the type and danger of chemical substances.

C) Treatment:

-Chemical wastes may be subjected to special treatment to reduce their toxicity or to convert them into less hazardous substances.
-Chemical treatment methods include:
1. Using of chemicals to neutralize acids or bases
2. Using oxidation or reduction processes to break down toxic compounds.

D) Final disposal:

After treatment, wastes are disposed of in safe ways, such as

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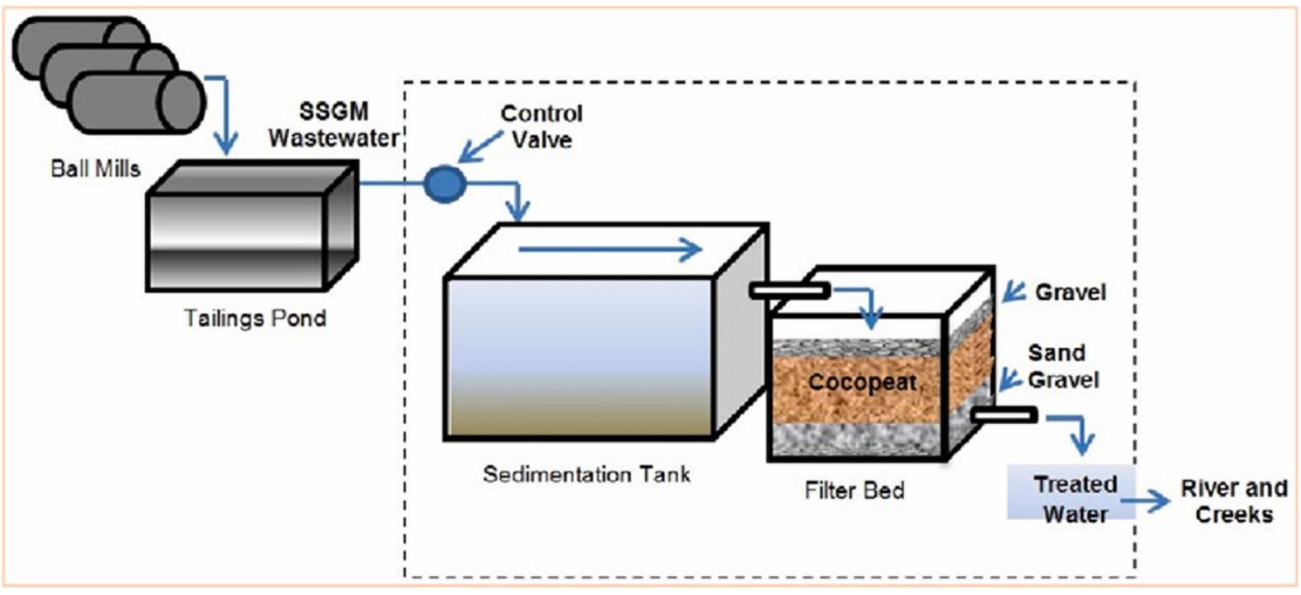
1. Burial in private landfills	2. Burning in high-temperature furnaces	3. Recycling
Waste is buried in special designed landfills to prevent the leakage of chemical substances into the soil or ground water. These burials are equipped with insulating layers and leak control systems.	Some chemical wastes can burn in special furnaces that reduce the volume of waste and eliminate its toxicity. These ovens operate at high temperatures to ensure that waste is decomposed completely.	Some chemical waste can be recycled and used again. For example, some chemical solvents can be purified and reused in other industrial processes.

Monitoring and follow-up:

After the disposal of chemical wastes, the sites of final disposal must be monitored to ensure that no leakage or contamination occurs.
Environmental standards and regulatory procedures must be followed to ensure compliance with laws and protect the environment.

Example

Waste treatment from mining operations involves the use of methods such as chemical deposition or the use of filters to remove heavy metals from wastewater



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Questions

Multiple-Choice Questions

1-What is natural resource depletion?

a) The process of conserving resources
b) Consuming resources faster than they can be replenished
c) Increasing resource production
d) None of the above

2-Which of the following is a common method of extracting minerals?

a) Farming b) Mining c) Fishing d) Recycling

3-What is a significant environmental impact of mining?

a) Increase in biodiversity b) Soil erosion and habitat destruction
c) Improved air quality d) None of the above

4-What happens to soil layers during mining?

a) They become richer b) They are removed
c) They are preserved d) They are strengthened

5-What is acid drainage?

a) A process that enriches soil b) The release of acidic water from mining sites
c) A method of recycling water d) None of the above

6-What physical effect does mining have on the environment?

a) Decreased temperature b) Change in energy distribution
c) Increase in humidity d) Reduction in pressure

٧-What is a common chemical used in gold extraction?

a) Sulfuric acid b) Cyanide c) Hydrochloric acid d) Nitric acid

8-Which method is used to extract aluminum from bauxite?

a) Distillation b) Electrolysis c) Filtration d) Combustion

9-What is the primary purpose of chemical analysis before mining?

a) To determine the aesthetic value of minerals
b) To assess the feasibility of mining
c) To predict weather patterns
d) To evaluate soil health

10-Which process is involved in extracting iron from hematite?

a) Electrolysis b) Carbon reduction in a blast furnace
c) Filtration d) Distillation

11-What is the role of chemistry in mining?

a) It has no role b) It helps in the extraction and refining of minerals
c) It only analyzes soil quality d) It is only used in waste disposal

12-What is a potential consequence of mining operations on water quality?

a) Improved pH levels b) Contamination of groundwater
c) Increased oxygen levels d) Decreased mineral concentrations

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13-What type of waste is generated from mining?
a) Organic waste b) Chemical waste
c) Non-toxic waste d) Biodegradable waste

14-What is the first step in chemical waste disposal?
a) Monitoring sites b) Classification and separation
c) Burning waste d) Final disposal

15-What is one method for treating chemical waste?
a) Burial in regular landfills b) Chemical treatment
c) Incineration without regulation d) Open dumping

16-Why is it important to monitor disposal sites for chemical waste?
a) To ensure waste is reused b) To prevent leakage and contamination
c) To expand landfill capacity d) To increase waste production

17-What can be an effect of deforestation on biodiversity?
a) Increased species diversity b) Loss of habitat and species extinction
c) Improved ecosystem stability d) None of the above

18-How does mining contribute to soil erosion?
a) By planting trees b) By removing vegetation and topsoil
c) By enriching the soil d) By improving soil structure

19-What chemical reaction occurs when fossil fuels are burned?
a) Combustion b) Fermentation c) Oxidation d) Distillation

20-What is the main purpose of recycling chemical waste?
a) To increase toxicity b) To reduce waste volume
c) To reuse hazardous materials d) All of the above

21-What is a major risk of improper disposal of chemical waste?
a) Enhanced soil fertility b) Environmental pollution
c) Increased biodiversity d) None of the above

22-What happens during chemical precipitation in waste treatment?
a) Waste is burned b) Solids are separated from liquids
c) Waste is buried d) Waste is recycled

23-What is the primary goal of chemical waste disposal?
a) Economic profit b) Environmental protection
c) Increased resource extraction d) Waste minimization

24-Which mining process involves the use of a blast furnace?
a) Aluminum extraction b) Gold extraction
c) Iron extraction d) Silver extraction

25-What role does activated carbon play in gold extraction?
a) It burns the waste b) It absorbs gold from solution
c) It enhances water quality d) It separates soil from minerals

26-What effect does mining have on local ecosystems?
a) Enhances biodiversity b) Disrupts habitats
c) Stabilizes soil d) Reduces pollution

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27-What is a common method to manage hazardous chemical waste?
a) Open dumping b) Incineration at high temperatures
c) Mixing with non-hazardous waste d) Allowing it to degrade naturally

28-What is an example of chemical waste?
a) Plastic bottles b) Organic food scraps
c) Heavy metals from mining d) Paper products

29-What happens to the pH of water contaminated by mining?
a) It remains neutral b) It becomes more alkaline
c) It can become acidic d) It improves

30-What is the environmental consequence of erosion caused by mining?
a) Increased soil fertility b) Loss of arable land
c) More stable ecosystems d) None of the above

31-Which of the following is a method of reducing mining waste?
a) Increasing extraction rates b) Recycling minerals
c) Open-pit mining d) None of the above

32-What is the main chemical used in the extraction of iron from hematite?
a) Cyanide b) Coke c) Sulfuric acid d) Sodium hydroxide

33-How does resource depletion affect public health?
a) It has no effect b) It can lead to toxic exposure and health issues
c) It improves overall health d) It increases access to clean water

34-What is a potential long-term impact of mining on water resources?
a) Improved water quality b) Increased water availability
c) Contamination of local aquifers d) None of the above

35-What is the purpose of using filters in wastewater treatment from mining?
a) To increase waste volume b) To separate heavy metals
c) To enhance chemical reactions d) To improve soil quality

36-What is a common environmental regulation regarding chemical waste?
a) No regulations exist b) Waste can be disposed of anywhere
c) Strict standards for disposal and treatment d) Regulations only apply to solid waste

37-Which of the following is NOT a type of chemical waste?
a) Toxic waste b) Biodegradable waste c) Radioactive waste d) Flammable waste

38-What can be a result of chemical runoff from mining sites?
a) Enhanced plant growth b) Water source contamination
c) Improved soil quality d) Increased biodiversity

39-What is the main function of a blast furnace?
a) To neutralize waste b) To convert iron ore into iron
c) To recycle metals d) To extract oil

40-What is one consequence of habitat destruction due to mining?
a) Increased species richness b) Loss of biodiversity
c) Enhanced ecological balance d) None of the above

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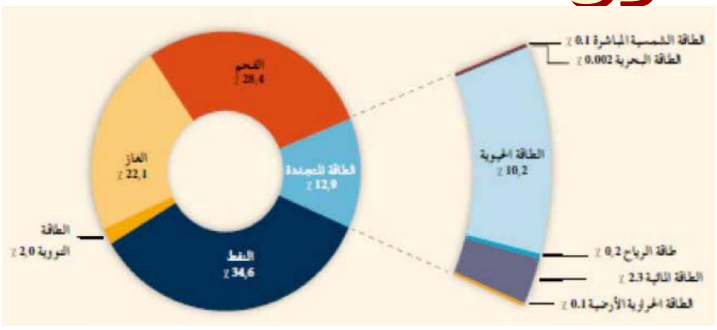
Lesson Three Renewable energy



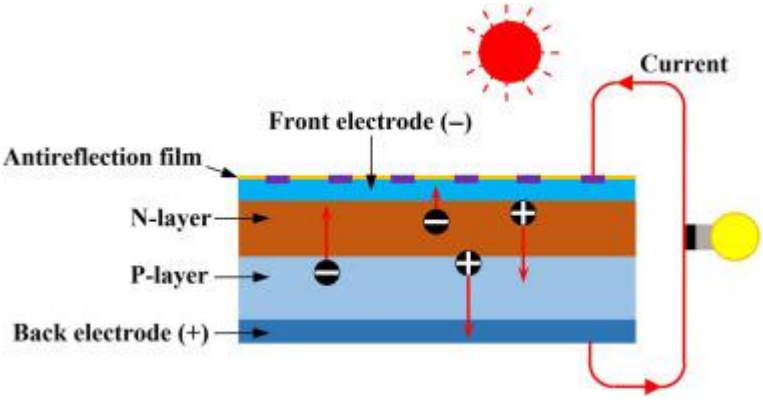
Renewable energy sources:

1. Solar energy

Solar cells:

They consist of semiconductors that convert solar energy directly into electrical energy.

- They are considered from the modern methods that **preserve the environment** and **reduce pollution** resulting from the use of fossil fuels in obtaining electrical energy.



1. When light falls on the surface of a semi-conductor material as silicon, photons of light shift electrons to one of their surfaces.
2. A potential difference is created between the two surfaces, which can create an electric current if connected to an external circuit.

- To determine the efficiency of solar cells,
we compare the electrical energy produced with the light energy provided by the sun.
If the cell is able to convert all the light energy that falls on it into electrical energy, its efficiency is 100%.
In practical applications there are no ideal solar cells.

☞Factor affecting the efficiency of the solar cells

1. The angle of inclination of sun rays
2. Presence of clouds
3. Environmental factors as wind, humidity and dust

Science has recently developed techniques to improve the efficiency of solar cells, where the use of nanotechnology, in which materials have new distinctive properties on solar cells, which are characterized by a high ability to absorb sunlight to increase its efficiency.

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➢ **Electric energy (E) in joule is calculated from the relation:**

$$E = V \times I \times t$$

Where,

E is the electric energy in joule (J)

V is the electric potential energy in volt (v)

I is the electric current intensity in ampere (A)

t is the time of passing the electric current in second (s)

➢ **In practical applications, we deal with the power (P),**

the produced or consumed energy per second and its measuring unit is watt (W)

Power is calculated from the relation:

$$P = I \times V$$

$$\text{Electric cell efficiency} = \frac{\text{Electric power produced}}{\text{Solar power fall on the cell}} \times 100$$

➢ **Example** **A Sheet of photo cell produces a pOtentia; difference of 10v and a current intensity 0.5A** when a circuit connected to it is closed, calculate the electrical power it produces.

Solution

P = I x V P = ٠.٥x ١٠=5 watt (W)

➢ **Think: If you have a solar cell installed on the roof of a house. This solar cell works at 20% efficiency.**

1.If sunlight provides 1000 W/m^2 of solar energy on the cell surface, how much electricity does solar cell produce per square meter?

2. If the solar cell area is 2 m^2, what is the total electrical power produced by the sheets?

3. How can the production of electrical energy from the solar cell be increased?

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2. Wind energy

Wind energy is one of the most important environmentally **friendly alternative energy sources** that depend on **converting wind energy into clean electrical energy.**
It relies in its work on the operating of wind turbines with air movement.

It consists of:

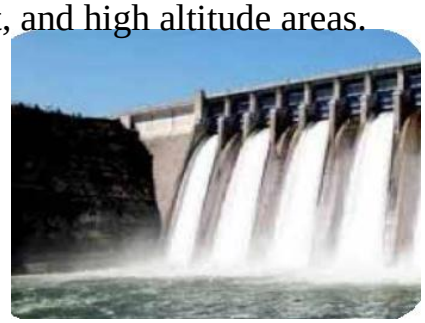
1. Streamlined, curved blades or fans
2. Turbines
3. Generators.

When the air current flows on both sides of the fans, **two areas with different atmospheric pressure are formed** as a result of the **difference in speed of air** on both sides of the fans that leads to their movement

The blades (fans) are connected by means of a rod to transport the movement to the turbines connected to the generators in order to **convert electrical energy into electrical energy.**

- The efficiency of wind mills depends on the **speed of wind** movement in the region, so it is preferable to build them in open areas such as the desert, and high altitude areas.

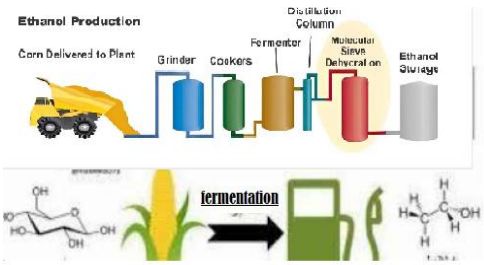
3. Hydroelectric energy



Dams are used to store water in a reservoir, and thus water acquires **potential energy** due to its new position

The dam contains **gates** to control the movement of water.
When the gates are opened, water flows from top to bottom in front of the dam to fall on turbines that rotate and this movement is transmitted to the generators that convert the kinetic energy into electrical energy.

4. Bioenergy



Bioenergy is produced **from organic materials such as plants and animals**.
These materials can be **converted into biofuels**, such as **ethanol** and **biodiesel**, or to electricity by burning them in electric power stations.

For example

Crops as **corn** and **sugar cane** are used to **produce ethanol** that is used as a substitute for **gasoline**. **Animals and agricultural residues can be used to convert them into energy** through fermentation or burning.
Bio energy contributes to **reducing carbon emissions compared to fossil fuels**, as the carbon released during the combustion of bio-fuel to the atmosphere is absorbed by plants.

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Questions

Multiple-Choice Questions

1-What is the primary source of solar energy?

a) Wind b) Sunlight c) Water d) Biomass

2-Which component converts sunlight into electricity in solar panels?

a) Turbines b) Photovoltaic cells c) Generators d) Batteries

3-What percentage of sunlight does a solar cell operating at 20% efficiency convert into electricity?

a) 10% b) 20% c) 50% d) 100%

4-What is the main advantage of wind energy?

a) It requires a lot of water b) It produces no carbon emissions
c) It's always available d) It is the cheapest form of energy

5-Where are wind turbines most efficiently placed?

a) Urban areas b) Forests
c) Open plains and high altitudes d) Coastal cities

6-What energy conversion occurs in hydroelectric power plants?

a) Chemical to mechanical b) Kinetic to electrical
c) Thermal to electrical d) Solar to kinetic

7-What is bioenergy primarily derived from?

a) Fossil fuels b) Organic matter
c) Nuclear reactions d) Geothermal sources

8-Which of the following biofuels is produced from corn?

a) Biodiesel b) Ethanol c) Methanol d) Propanol

9-How do solar cells increase their efficiency?

a) Using larger panels b) Utilizing nanotechnology
c) Increasing temperature d) Reducing size

10-What is a disadvantage of wind energy?

a) It produces greenhouse gases b) It is intermittent and depends on weather
c) It is too expensive d) It requires a lot of water

11-What type of energy is generated by the movement of water in a dam?

a) Thermal energy b) Mechanical energy
c) Potential energy d) Kinetic energy

12-Which of the following renewable energy sources emits no carbon dioxide during operation?

a) Natural gas b) Wind energy c) Coal d) Oil

13-What is the role of turbines in a hydroelectric power plant?

a) To store water b) To convert kinetic energy to electrical energy
c) To filter water d) To generate heat

14-Which renewable energy source is considered the most variable?

a) Solar energy b) Wind energy c) Hydro energy d) Geothermal energy

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15-What is the primary benefit of using biofuels compared to fossil fuels?
a) They are cheaper b) They are renewable and reduce carbon emissions
c) They provide more energy d) They are more efficient

16-Which of the following is a challenge associated with solar energy?
a) High operating costs b) Dependency on sunlight
c) High carbon emissions d) Limited availability

17-How does renewable energy contribute to combating climate change?
a) By increasing fossil fuel use b) By reducing greenhouse gas emissions
c) By promoting chemical pollution d) By increasing resource consumption

18-What is the main regulatory purpose regarding renewable energy installations?
a) To increase installation costs b) To ensure compliance with environmental laws
c) To limit energy production d) To discourage investment

19-Which renewable energy source relies on the Earth's internal heat?
a) Wind energy b) Solar energy c) Geothermal energy d) Bioenergy

20-What is a common method to increase the efficiency of wind turbines?
a) Increasing blade length b) Reducing speed
c) Using heavier materials d) Decreasing height

21-Which factor does NOT affect solar panel efficiency?
a) Temperature b) Angle of sunlight
c) Amount of rainfall d) Dust accumulation

22-What is one way to manage the challenges of wind energy?
a) Building more fossil fuel plants b) Using energy storage systems
c) Reducing installation size d) Limiting wind farm locations

23-What is the 'greenhouse effect'?
a) A process that cools the Earth b) The warming of the Earth due to trapped gases
c) A method of producing energy d) The conversion of solar energy

24-What is the potential environmental impact of biofuels?
a) Increased carbon emissions b) Habitat destruction
c) Enhanced biodiversity d) Lower water consumption

25-What is the primary purpose of a dam in hydroelectric power generation?
a) To create recreational areas b) To store water and release it for power generation
c) To filter pollutants from water d) To increase fish populations

26-Which renewable energy source can be harnessed both on land and offshore?
a) Solar b) Wind c) Geothermal d) Bioenergy

27-How does the use of solar energy help reduce chemical pollution?
a) By increasing fossil fuel reliance b) By reducing dependence on fossil fuels
c) By increasing water usage d) By promoting chemical fertilizers

28-What is a common use for geothermal energy?
a) Heating buildings b) Fueling cars
c) Generating wind power d) Producing biofuels

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29-What is the main challenge of integrating renewable energy into existing power grids?

a) High installation costs b) Inconsistent energy supply
c) Lack of technology d) Increased pollution

30-Which of the following is a non-renewable energy source?

a) Solar b) Coal c) Wind d) Biomass

31-What is the main advantage of using wind energy compared to fossil fuels?

a) It is more reliable b) It is less expensive to install
c) It produces no emissions d) It generates more energy

32-What type of energy is produced when biomass is burned?

a) Chemical energy b) Thermal energy c) Electrical energy d) Mechanical energy

33-Which of the following is a risk associated with hydroelectric power?

a) Deforestation b) Water scarcity c) Soil erosion d) All of the above

34-What is one benefit of using energy storage systems with renewable energy?

a) They increase carbon emissions b) They provide a consistent energy supply
c) They reduce installation costs d) They eliminate the need for renewable sources

35-Which renewable energy source has the highest potential for energy generation worldwide?

a) Solar energy b) Wind energy c) Geothermal energy d) Hydroelectric energy

36-What is a common practice to improve solar energy efficiency?

a) Increasing the size of panels b) Using tracking systems to follow the sun
c) Reducing the number of panels d) Installing in shaded areas

37-Which of the following renewable sources is the most predictable?

a) Solar energy b) Wind energy c) Hydroelectric energy d) Biomass

38-What is the primary barrier to widespread adoption of renewable energy?

a) Lack of technology b) High initial costs
c) Insufficient resources d) Regulatory challenges

39-What is the carbon footprint of biofuels compared to fossil fuels?

a) Higher b) Lower c) The same d) Unknown

40-Which renewable energy source can be used to produce hydrogen fuel?

a) Solar energy b) Wind energy
c) Both a and b d) None of the above

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Lesson Four Applications of renewable energy

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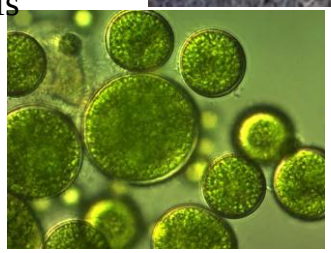
Using of living organisms in the production of renewable energy is an innovative field that combines the biology and technology to create sustainable energy sources. Renewable energy from living organisms depend on harnessing the natural biological processes that occur in these organisms. Research and development in this field continues to enhance our ability to harness natural resources in a way that preserves the environment and supports global energy aims.

Renewable bioenergy sources

1. Biomass (agricultural waste, such as rice straw, or certain types of plants, such as sugar cane) can be used to produce energy through fermentation and aerobic decomposition processes.

2. Minute algae and microbes produce biofuels through biological processes (as convert organic materials into electrical energy or liquid fuels).



3. Methane-producing bacteria can be used to decompose the organic matters in waste treatment plants or animal pens to produce methane as biofuel.

4. Specific enzymes are used to convert cellulose found in plants into sugar, which can be converted into **ethanol** (a type of hydrocarbon fuel).

5. Enzymes can be used to decompose fats from biological sources such as vegetable oils or animal fats and convert them to **biodiesel** (biofuel)

5. Minute algae grow rapidly and **convert light and organic materials into oils** that can be converted into **biodiesel**.

- **This type of fuel is a promising source** because it do**es not need a large agricultural area** and can grow in areas that are **not** suitable for agriculture.

6. The plants is a source of **renewable energy**, where plants are transformed through fermentation and decomposition of into biofuels

- Some aquatic plants, such as Nile roses or mosses, can be grown and used to produce **biodiesel** or **ethanol**.

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Plants can be used to produce the bio- mass that can be converted to different types of bio fuels.

7. Energy extracted from marine algae, is an innovative source of renewable energy, as it can be converted into **biofuels** due to its ability to grow rapidly and use marine resources sustainably.

- These algae can grow in seawater and do not need for agricultural land.

8. Photo-bacteria use light to convert carbon dioxide and water into biofuel effectively and sustainably such as **ethanol** or **hydrogen**.

The devices that work by solar energy in homes

1. Solar heaters

They are used to heat water in houses instead of the electric heaters thus reducing the use of electricity, which helps to save and reduce the value of the bill. These types of heaters are characterized with high efficiency and the possibility of using it throughout the year comfortably due to availability of the sun

2. Air conditioners

People in hot countries need air conditioners and cooling systems greatly.
Egypt is one of the places that are constantly exposed to sunlight, the option of air conditioners that work with solar energy is very suitable for the population, as its use reduces electric consumption

3. Solar lamps

Solar lamps can be used for **lighting**, **garden decoration** and are in case of **power outage**

- They are considered a **major alternative** to lighting and **consume less electricity**.
- **Solar lamps** work by placing them **under the sun's rays**, and include an automatic operation feature, in addition to being environmentally friendly and do not produce any exhaust

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Questions

Multiple-Choice Questions

1-What is one key benefit of using solar water heaters?

a) They increase electricity consumption
b) They reduce reliance on electric heaters
c) They produce carbon emissions
d) They require constant maintenance

2-Which renewable energy source is commonly used to power air conditioning systems?

a) Coal
b) Natural gas
c) Solar energy
d) Nuclear energy

3-How do solar lights contribute to energy savings?

a) They use fossil fuels
b) They rely on battery storage
c) They operate without electricity
d) They require constant recharging

4-What is biomass primarily derived from?

a) Fossil fuels
b) Organic materials
c) Minerals
d) Nuclear waste

5-Which process is commonly used to convert agricultural waste into biofuel?

a) Fermentation
b) Combustion
c) Distillation
d) Filtration

6-What is one advantage of using microalgae for biofuel production?

a) High land use
b) Slow growth rate
c) Ability to grow in non-arable land
d) High carbon emissions

7-How do methane-producing bacteria contribute to renewable energy?

a) They produce heat
b) They generate electricity
c) They produce methane from organic matter
d) They consume fossil fuels

8-What is the primary role of enzymes in renewable energy production?

a) To increase carbon emissions
b) To accelerate chemical transformations

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c) To store energy
d) To filter pollutants

9-Which of the following is a type of biofuel produced from fats?

a) Ethanol
b) Biodiesel
c) Methanol
d) Propanol

10-Which renewable energy source uses light to convert carbon dioxide into biofuels?

a) Solar energy
b) Wind energy
c) Phototrophic bacteria
d) Biomass

11-What is a primary application of solar energy in homes?

a) Heating swimming pools
b) Cooking food
c) Lighting gardens
d) Powering televisions

12-How do solar panels help reduce chemical pollution?

a) By increasing water usage
b) By reducing dependence on fossil fuels
c) By emitting sulfur dioxide
d) By improving soil quality

13-Which of the following renewable energy sources does NOT produce carbon dioxide during power generation?

a) Natural gas b) Wind energy c) Coal d) Oil

14-What type of energy is produced from seaweed?

a) Solar energy b) Geothermal energy
c) Biofuel d) Wind energy

15-Which appliance can be powered by solar energy to enhance energy efficiency?

a) Electric oven b) Solar heater
c) Gas stove d) Electric kettle

16-What is a benefit of using solar-powered air conditioners?

a) Increased electricity bills
b) Reduced energy consumption
c) Higher carbon emissions
d) Limited efficiency

17-How do solar-powered garden lights operate?

a) By using batteries
b) By relying on fossil fuels
c) By converting sunlight into electricity
d) By using chemical reactions

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18-Which of the following is a key challenge for biomass energy production?

a) High availability
b) Land use competition
c) Low energy yield
d) Increased emissions

19-What is the main purpose of using renewable energy technologies?

a) To increase fossil fuel dependence
b) To reduce greenhouse gas emissions
c) To limit energy production
d) To raise energy costs

20-Which type of biofuel is derived from the fermentation of sugars?

a) Ethanol
b) Biodiesel
c) Methanol
d) Propanol

21-What is a major advantage of using microalgae for biofuel production?

a) Requires large land areas
b) Grows slowly
c) Can be cultivated in seawater
d) Produces high emissions

22-How does solar energy help reduce energy bills in homes?

a) By increasing energy consumption
b) By providing free energy from the sun
c) By requiring expensive equipment
d) By reducing the need for appliances

23-What is the environmental benefit of using renewable energy sources?

a) Increased air pollution
b) Decreased biodiversity
c) Reduced carbon footprint
d) Higher greenhouse gas emissions

24-Which renewable energy source is often used in waste treatment plants?

a) Solar energy
b) Bioenergy
c) Wind energy
d) Geothermal energy

25-Which of the following is NOT a characteristic of renewable energy?

a) Sustainable
b) Finite
c) Low emissions
d) Environmentally friendly

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Chapter Three Resources recycling and investment

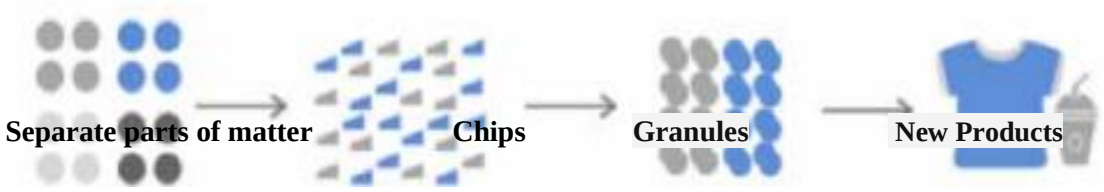
Lesson One Importance of resource recycling

Resource recycling is the process of reusing materials that have already been used, turning them into new products instead of disposing of them as waste.
This process plays a vital role in achieving sustainable development, as it contributes to reducing pressure on natural resources and reducing environmental pollution.

Types of recycling

1. Mechanical cycling

The most common method in the world, in **which the non-decomposed residues** of the material are collected and **re-introduced back** into the same industry to go through the same stages of **manufacturing again** and form a product of the same type



2. Energy recycling

A method that is used only with the remnants of the plastic, where it is converted into electrical energy or thermal energy through the passage of the plastic through the process of burning to convert it into fuel
When recycling resources, we reuse the energy that was present in the primary materials instead of consuming new energy.
Example **Recycling aluminum** saves about 95% of the energy required to produce aluminum from bauxite (aluminum oxides Al_2O_3)

$$2\ Al_2O_3 \xrightarrow{\text{Electrolysis}} 4\ Al + 3O_2$$

This process is carried out with electrolysis and requires high electrical energy.
In the recycling process, the consumed aluminum is simply remelted and reshaped, requiring much less energy.
From the physical equation:

Saved energy = energy used in original production - energy used in recycling

Example:
If the **production** of a ton of aluminum from a waste material requires **15,000 k Watt/h**,
-But **recycling** the same amount requires only **750 k Watt/h.**

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Note:

Despite the significant benefits of energy cycling, negative aspects such as air pollution from waste burning should be taken into account. Therefore, more sustainable technologies for energy recycling must be developed.

3. Chemical recycling

Chemicals are added to wastes to obtain basic materials, or used to decompose animal remains to obtain biogas

Examples:

a. Electronic waste decomposition: Chemical materials such as acids can be used to separate precious metals such as gold and copper from electronic waste.

b. Expired drug decomposition: Using acids or bases to break down expired medications into harmless compounds

4. Pyrolysis

A chemical process occurs at high temperatures in the absence of oxygen, where organic waste is decomposed into simpler components such as gases, low-density liquids (such as bio oils) and solid substances.

5. Chemical Sterilization

It involves the use of chemical reactions to neutralize toxic or harmful substances in wastes.

Examples:

a. Neutralize of acids or bases: In chemical wastes, acids or bases can be neutralized by anti-substances such as sodium carbonate or sodium hydroxide.

Example:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Hydrochloric acid reacts with sodium hydroxide to form sodium chloride (table salt) and water. This is a complete neutralization reaction that results in a neutral solution.

b. Medical waste treatment: Chemicals such as chlorine or ozone are used to treat medical waste to kill bacteria and viruses

6. Biochemical reactions:

Using living organisms or enzymes to convert the organic wastes into fertilizers

Examples

a. Bio-decomposition:

Organic wastes such as food residues can be converted into organic fertilizers through chemical reactions with the help of microorganisms.

b. Converting wastes into biofuels:

Certain bacteria decompose organic wastes into biofuels such as ethanol.

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Chemical processes such as pyrolysis, chemical decomposition, chemical sterilization, chemical recycling, and chemical bioreactivity are essential tools for converting waste into reusable resources.
These processes help reduce the volume of waste, reduce pollution, and turn unusable materials into useful resources.

Recycling Impacts Maintaining Environmental Balance:

Recycling one ton of paper protects 17 trees and saves 70% of energy and 85% of water necessary for new paper production.
By recycling all newspapers, we can reduce carbon dioxide emissions by 20 million tons per year, which is equivalent to removing 5 million cars from the roads.

Sustainable City of the Future

Imagine living in the year 2050 in a city that relies entirely on renewable energy and advanced recycling of resources. In this city, no waste is sent to landfills and everything is recycled using the latest chemical and physical technologies. Factories use chemical recycling techniques to produce new materials from plastics, metals and glass, reducing the depletion of natural resources and limiting pollution.

One of the biggest challenges the city faces is dealing with the large amounts of plastic it uses, which is difficult to break down in nature. Using new technology to chemically break down plastic, the city is converting it back into its basic materials to produce new, reusable materials.

You are part of a research team that is evaluating the efficiency and benefits of using chemical technology to recycle plastics compared to conventional methods. The team is also working on developing new ways to improve the recycling of aluminum and glass using chemical technologies.

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lesson one exercise

1-What is the basic process in resource recycling?

a) Waste disposal b) Reusing materials c) Waste burning d) Waste burial

2- Which of the following is an example of mechanical recycling?

a) Burning plastic to produce energy b) Reassembling plastic and converting it into new products

c) Using acids to decompose waste d) Analyzing biological waste to produce biogas

3- What type of energy is consumed in the production of aluminum from bauxite?

a) Thermal energy b) Electrical energy c) Chemical energy d) Mechanical energy

4-What is the approximate percentage of energy saved when recycling aluminum?

a) 25% b) 50% c) 75% d) 95%

5-Which of the following represents a drawback of energy recycling?

a) Reduced energy consumption b) Reduced air pollution

c) Production of renewable energy d) Increased air pollution

6- What is the process in which chemicals are used to convert waste into basic materials?

a) Mechanical recycling b) Energy recycling c) Chemical recycling d) Thermal decomposition

7-Which of the following is an example of using pyrolysis?

a) Analyzing organic waste to produce biogas b) Separating precious metals from electronic waste

c) Burning plastic to produce energy d) Recycling plastic into new products

8-Which of the following is an example of chemical sterilization of waste?

a) Separating metals from electronic waste b) Analyzing expired medications

c) Neutralizing acids or bases in waste d) Converting waste into fertilizer

9-What is the process that uses living organisms or enzymes to convert organic waste?

a) Thermal decomposition b) Biochemical reaction

c) Chemical sterilization d) Mechanical recycling

10-Which of the following is an example of biological decomposition?

a) Converting plastic into fuel b) Converting organic waste into fertilizer

c) Converting waste into recyclable materials d) Recycling metals

11- What is the purpose of using chemical processes in recycling plastic?

a) To increase the volume of waste b) To reduce pollution

c) To convert plastic into recyclable materials d) To increase waste treatment costs

12- Which of the following represents the importance of recycling resources in preserving biodiversity?

a) Increasing air pollution b) Reducing the need to extract resources

c) Increasing land use d) Increasing energy consumption

13-Which of the following represents a benefit of chemical recycling of plastic?

a) Increasing harmful emissions b) Reducing energy consumption

c) The possibility of reusing plastic in new applications d) Increasing the volume of waste

14-What is the process that uses a magnet to separate metals from waste?

a) Electrostatic separation b) Thermal decomposition

c) Magnetic separation d) Biochemical reaction

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15- What is the process that uses electrical charges to separate materials?

a) Magnetic separation b) Electrostatic separation
c) Biological decomposition d) Thermal decomposition

16-What materials can be separated using electrostatic separation?

a) Only metals b) Only plastic
c) Metals and plastic d) Organic waste

17- What role does magnetic separation play in the automotive industry?

a) Separating precious metals b) Separating metals from other components
c) Analyzing organic materials d) Converting waste into fertilizer

18-What is the main condition for static electricity to occur?

a) Movement of electrical charges b) Balance of electrical charges
c) Imbalance of electrical charges d) The presence of a magnetic field

19-Which of the following is an example of generating static electricity by friction?

a) Connecting a wire to a power source b) Touching a charged object with a neutral object
c) Rubbing a balloon with your hair d) Approaching a charged object with a conductive object

20-What is the process in which waste is heated in the absence of oxygen?

a) Biological decomposition b) Thermal decomposition
c) Mechanical recycling d) Chemical recycling

21- Why is the reprocessing process important in glass recycling?

a) Just for cleaning the glass
b) Just to reduce the volume of glass
c) To break down glass into its basic components and reuse them
d) To convert glass into other non-recyclable materials

22-How do resource recycling techniques contribute to reducing the environmental impact of resource extraction?

a) Increasing the need to extract resources b) Reducing the need to extract resources
c) Not affecting resource extraction d) Increasing energy consumption in resource extraction

23-What is the relationship between resource recycling and the circular economy?

a) Recycling conflicts with the circular economy
b) Recycling is an essential part of the circular economy
c) Recycling is not related to the circular economy
d) Recycling leads to an increase in waste in the circular economy

24- What are the challenges facing the widespread use of chemical recycling?

a) The ease of the process and its low cost
b) The efficiency of the process and its ability to handle large quantities
c) The high cost, difficulty of reusing by-products, and environmental impact
d) The lack of need for by-products

25- What is the importance of magnetic separation in the process of extracting metals?

a) Increase energy consumption
b) Simplify the extraction process and increase output
c) Increasing environmental pollution
d) Increase extraction cost

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Essay Questions (5)

1- Compare mechanical recycling and chemical recycling in terms of the processes used, benefits, and challenges.

2-Explain how magnetic and electrostatic separation contribute to reducing the depletion of natural resources and limiting environmental pollution.

3-Describe in detail the steps of the glass recycling process, and how chemical reactions contribute to this process.

4-Discuss the importance of resource recycling in maintaining biodiversity in ecosystems, and provide examples to support your answer.

5-What are the challenges facing plastic recycling, and how can chemical technology help overcome them?

Answer Keys

Multiple Choice Answers:

1. B 2. B 3. B 4.d 5.d 6. c 7. a 8. c 9. B 10. b 11.c 12.b 13.c 14.c 15.b
16.c 17.b 18.c 19.c 20.b 21.c 22.b 23.b 24.c 25.b

Essay Question Answers:

1-Comparison of Mechanical and Chemical Recycling:

Mechanical Recycling: Relies on physical processes like collection, sorting, and grinding to recycle materials without altering their chemical composition. Benefits include ease of implementation and low cost, but challenges lie in the quality of recycled materials and the limited range of applications.

Chemical Recycling: Involves using chemical substances to break down waste into its basic components or convert it into other valuable materials. Benefits include the ability to obtain high-quality materials and expand the range of recyclable materials, but challenges include high cost and the potential environmental impact of the chemical substances used.

2-Contribution of Magnetic and Electrostatic Separation:

Magnetic Separation: Uses strong magnets to separate metals from waste, which reduces the extraction of new metals and limits the environmental impact of mining.

Electrostatic Separation: Uses electrical charges to separate different materials, which contributes to separating plastics and glass and reduces the need to produce these materials from primary sources.

3- Glass Recycling Process:

Collection and Sorting: Used glass is collected and sorted by color and type.
Crushing and Cleaning: The glass is crushed into small pieces and cleaned to remove impurities.
Melting: The glass is melted in special furnaces to produce molten glass.
Shaping: The molten glass is shaped into new products.

4- Role of Chemical Reactions: Chemical reactions are used to decompose glass into its basic components such as silica, and to reuse them in the manufacture of glass.

5- Importance of Recycling in Preserving Biodiversity:

Reduced Resource Extraction: Recycling reduces the need for mining and logging, which preserves habitats and reduces the loss of biodiversity.
Reduced Pollution: Recycling reduces pollution from industries and extraction, which maintains the health of ecosystems and the life of living organisms.
Examples: Recycling paper reduces logging, and recycling plastic reduces ocean pollution.
Challenges of Plastic Recycling and the Role of Chemical Technology:
Challenges: Difficult decomposition, large diversity of plastic types, high cost.
Role of Chemical Technology: It can convert plastic into basic materials or transform it into valuable new materials, and reduce harmful emissions. It can also help in analyzing plastic into its primary components, making it easier to reuse.

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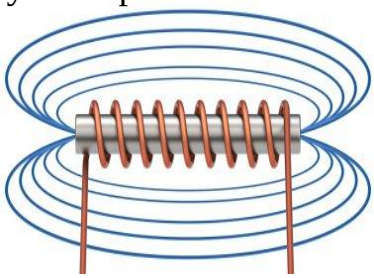
Lesson Two Resource recycling techniques and their impact on the environment

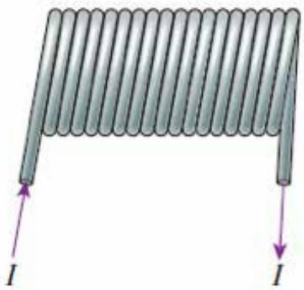
Modern technologies in resource recycling:

These depend on using advanced **chemical** and **physical** processes to **convert waste into reusable materials.** This contributes to **reducing the depletion of natural resources and reducing environmental pollution.**
These innovations contribute to sustainability and a circular economy.

A) Magnetic separation:

The idea of magnetic separation depends on passing of a strong electromagnet on the remnants of metals in the factory.
When a large electric current passes in a coil, it turns into a temporary magnet that attracts magnetic materials around it and separates them from other materials, and this method is considered one of the effective ways to separate metals.





Structure and work of the electromagnet

1. A coil of a wire made of copper with a large number of turns
2. The coil wrapped around a rod of wrought iron
When the two ends of the coil are connected to an electrical source and the electric current passes, and a magnetic flux is generated inside the coil, which works to convert the rod into a magnet

☞**The magnetic field strength depends on**

1. The number of coil turns
2. The intensity of the electric current
3. The type of the iron rod.

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Magnetic separation applications and their role in energy recycling:

1. Recycling

It can separate metals from residues and waste based on their magnetic capacity. This promotes the sustainable use of resources and reduces the impact of wastes and residues on the environment, making it an indispensable tool in recycling globally.

2. Cleaning and treatment of the environment

It helps in the disposal of magnetic pollutants in the water and soil, and contributes to the restoration of environmental balance.

3. Food and drug processing

It is used to support the standards of purity and safety in food and drug materials, and ensures the accurate separation of materials to acheive the standards of quality and safety.

4. Mining and mineral processing industry

It plays an important role in the extraction of valuable minerals from deposits (rocks and sediments), simplifying the extraction process and increasing yield.

5. Chemical and petrochemical industry

It contributes to the production process, purification of materials and removal of impurities, to achieve the standards of quality in the industry.

6. Electronic industries

It plays a crucial role in the recovery of precious metals such as copper and gold from electronic remains. This contributes to reducing pollution resulting from the unsafe disposal of old electronic devices, and reduces the need to extract more of these minerals from nature.

7. Automotive (Cars) industry

It is used to separate iron parts and steels from other components of old cars, making it easier to recycle them into new raw materials for new automotive industry.

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B) Electrostatic separation

Static electricity: a physical phenomenon that occurs as a result of an imbalance of electrical charges within or on the surface of a material.

When a substance loses some electrons (negatively charged particles) it becomes positively charged, and vice versa. This charge remains static and only moves when an electrical discharge occurs. This charge remains static and only moves when an electrical discharge occurs.

How is static electricity generated?

Static electricity is generated by several factors, including:

1. Friction	2. Contact	3. Induction
When rubbing their bodies against each other, electrons move from one object to another, causing them to charge oppositely. **Example:** When you rub a balloon with your hair, electrons transfer from your hair to the balloon. The hair becomes positively charged and the balloon becomes negatively charged	When a charged body touches a neutral body is, some electrons transfer from the charged body to the neutral body, charging the neutral body.	When a charged body approaches a conductor body, the charges are distributed in the conductor body so that the opposite charges accumulate on the nearest surface to the charged body.

☞Examples of static electricity in our daily life:

1. A small electric shock when touching the metal door handle in winter

This occurs due to the accumulation of electrical charges in the body as a result of friction with woolen clothes

2. Hair attracting into the plastic comb after combing

This occurs due to the transfer of electrons from the hair to the comb, which leads to charging them with opposite charges

3. Sticking the balloon on the walls after rubbing the hair

This happens because of the electrostatic force that attracts the negatively charged balloon to the wall that has a positive charge

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☞Electrostatic separation process

1. The idea is based on the exposure of a mixture of particles such as plastic to an electric field, which leads to these particles to gain positive and negative charges based on the properties of each material
2. Then a positive charged rod and another negatively charged rod are dipped inside the charged particles mixture
3. The positive rod will attract the particles having the negative charge and vice versa

The electrostatic separation method is characterized by a high ability to separate a large mixture of materials that are similar in shape, size and color, but different in electrical properties so that they can acquire charges opposite to each other.

☞Disadvantages of this process

1. It needs a high degree of control of the electric current on the mixture
2. It needs to control the surrounding conditions, as any change in humidity, degree of heat or in the electric voltage will affect the separation process.

☞Examples of electrostatic separating of some materials:

1. Plastic and minerals: Plastic (such as polyethylene or polypropylene) can be separated from metals (such as aluminum or copper) based on the different charges that each type of material acquires in the electric field.

2. Plastic and glass: Plastic (such as PVC) can be separated from glass as they have opposite charges when exposed to an electric field.

3. Wheat and mineral impurities: In agriculture, electrostatic separation can be used to separate seeds such as wheat from mineral impurities or other pollutants.

C) Thermocycling

The process of reusing a material by utilizing its energy after its initial use.
This is done by heating solid or liquid wastes to high temperatures to extract energy or converting it into new usable materials.

☞Examples of thermocycling:

1. Thermal plastic recycling:

Some types of plastics, such as polyethylene terephthalate (PET) and low density polyethylene (LDPE).
The process involves heating the plastic to a suitable temperature to melt, and then turning it into another form, such as new bottles or bottles.

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2. Thermal Rubber Recycling:

Old rubber tires can be cut and heated for reuse in asphalt making, or recycled into other rubber products. Heat helps break up the chemical bonds of rubber to facilitate its reshaping.

3. Wastes pyrolysis:

In this process, the organic or plastic wastes waste is heated in the absence of oxygen, resulting in its decomposition into combustible gases, liquids, and solid coal that can be used as an energy source or as raw materials in other industries.

4. Burning of wastes to produce energy (Waste – to – Energy):

In some cases, solid waste is used to generate electricity or waste.
This method is considered a type of recycling **(G. R)** where the energy stored in the waste is converted into electrical or thermal energy that can be used to heat buildings or operate power stations.
Thermal recycling plays an important role in reducing the volume of wastes and restoring energy, but it needs strict measures to reduce harmful emissions from burning or heating processes.

Retreatment:

The process in which, the materials are broken down into their basic components using chemical reactions.
Example, in glass recycling, bottles are crushed and melted in special furnaces to turn them into reconfigurable glass.

Example:

Reaction of silica with hydrochloric acid for the analysis of glass materials

$$SiO_2 + 4HCl \longrightarrow SiCl_4 + 2H_2O$$

Where:
- SiO_2 Silicon dioxide (sand): the main component of glass
- HCl Hydrochloric acid
- $SiCl_4$ Silicon tetrachloride which is a volatile liquid
- H_2O Water

Ecosystem Health Assessment:

Resource recycling techniques
- Reduce the need to extract new resources, reducing the environmental impact of mining and material extraction.
- Contribute to reducing waste dumped in landfills, preserving the health of ecosystems and biodiversity.

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Exercise lesson two

1. What principle is magnetic separation based on?

   a) The density of materials
   b) The electrical conductivity of materials
   c) The magnetic properties of materials
   d) The size of the materials

2. What is a solenoid coil composed of?

   a) Plastic and glass
   b) Copper wire wrapped around an iron rod
   c) Rubber and carbon
   d) Aluminum and plastic

3. Which of the following is a benefit of using magnetic separation in recycling?

   a) Increase pollution of water
   b) Increase use of landfills
   c) Increase waste volume
   d) Reduces impact of waste on the environment

4. What is the role of magnetic separation in the preparation of food and pharmaceuticals?

   a) Separate food from other things
   b) Support standards of purity and safety
   c) Increase the taste of food
   d) Support a fast manufacturing process

5. What kind of electric charge does a material acquire after losing electrons?

   a) Negative
   b) Positive
   c) Neutral
   d) No charge

6. How is static electricity produced by friction?

   a) A chemical reaction
   b) Movement of electrons from one object to another
   c) The contact of a charged object with a neutral object
   d) The presence of magnetic field

7. What happens when a charged object touches a neutral object?

   a) The neutral object becomes more charged.
   b) The neutral object becomes charged by contact.
   c) The charged object becomes neutral.
   d) No change occurs

8. What is pyrolysis?

   a) The process of using chemicals to recycle waste
   b) The process of heating waste in the absence of oxygen
   c) The process of separating metal using magnets
   d) The process of separating plastic using electric fields

9. Which of the following is an example of the use of thermal recycling of plastics?

   a) Converting plastic to fuel
   b) Recycling plastic to new products

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c) Using plastic to make glass
d) Separating plastic and metals

10. What is the main purpose of reprocessing?
a) Cleaning the used materials
b) Crushing materials
c) To break down the materials into basic components for reuse
d) Disposing of the materials

11. What is a major drawback of the electrostatic separation method?
a) It is an expensive process.
b) It is a slow process
c) It requires tight control of conditions
d) It is not as effective as other methods

12. What materials can be separated using electrostatic separation?
a) Only metals b) Only plastic
c) Metals and plastic d) Organic materials

13. Which of the following is an example of electrostatic separation in agriculture?
a) Separating iron from steel b) Separating glass from plastic
c) Separating wheat from impurities d) Separating rubber from metal

14. How does thermal recycling differ from chemical recycling?
a) Thermal recycling uses heat, chemical recycling uses chemical reactions.
b) Thermal recycling uses chemicals, chemical recycling uses heat
c) Thermal recycling is a physical process, chemical recycling is a biological process.
d) Thermal recycling is a biological process, chemical recycling is a physical process.

15. What is the primary purpose of using pyrolysis in thermal recycling?
a) To convert waste into energy b) To convert waste into reusable materials
c) To reduce the volume of waste d) To reduce air pollution

16. How do thermal and chemical recycling contribute to sustainability?
a) Increase waste b) Reduce waste volume and save energy
c) Increase reliance on fossil fuels d) Promote deforestation

17. What is the role of microorganisms in the biological decomposition process?
a) They create pollution b) They accelerate the breakdown of organic materials
c) They neutralize acids and bases d) They separate metals and plastics

18. Which of the following is not a benefit of static electricity?
a) A balloon sticking to a wall b) Hair being attracted to a comb
c) Recycling materials by using electrostatic separation d) A thunderstorm

19. Which of the following is a chemical used for sterilizing waste?
a) Hydrochloric acid b) Sodium carbonate
c) Chlorine d) Biogas

20. Which step is essential in the glass recycling process after crushing the used glass?
a) Heating the glass to a high temperature b) Chemical analysis of the glass

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c) Cleaning the crushed glass
d) Disposing of the crushed glass

21. What is the main principle of "conserved energy" in the context of recycling?

a) Energy can be created by recycling.
b) Energy used in recycling is always less than the energy required for original production.
c) Energy in recycling is destroyed to produce other forms of energy
d) Total energy in a closed system always decreases with time

22. Why is it important to consider both the benefits and drawbacks of thermal recycling?

a) To ignore air pollution
b) To minimize reliance on renewable resources
c) To develop more sustainable ways of thermal recycling
d) To reduce the efficiency of the recycling process

23. What are the challenges in separating different types of plastics using electrostatic separation?

a) Difficulty in controlling the environmental factors
b) Difficulty in charging the plastics
c) Difficulty in separating the metals from plastics
d) Difficulty in creating the electric field

24. How does the concept of "imbalance of electrical charges" help us understand static electricity?

a) The imbalance creates the electric current needed
b) The imbalance creates an accumulation of charges in the material
c) The imbalance allows electrons to move freely
d) The imbalance creates magnetic fields that push charges away

25. How do chemical reactions facilitate the recycling of materials like glass?

a) By destroying the glass
b) By melting the glass in special furnaces
c) By transforming the glass into its basic components
d) By removing impurities in the glass

Essay Questions)

1. Compare the process of using magnetic separation and electrostatic separation in the recycling of resources. Describe the differences in the properties of the materials that enable the separation, and their applications.
2. Explain how the chemical processes of pyrolysis and chemical decomposition contribute to the recycling of waste. Describe the products from each process, and their importance in resource recovery.
3. Discuss the role of static electricity in various applications and explain the benefits and drawbacks of these processes
4. Evaluate the benefits of reusing materials through thermal recycling, and discuss its challenges, considering the negative impacts of the heat or smoke caused by this process.
5. Explain how a chemical reaction could be used to break down glass into its basic components for recycling purposes.

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Answer Key

Multiple Choice Answers:

1. C 2.b 3.d 4.b 5. B 6. B 7. B 8.b 9.b 10-c 11.c 12. C 13.c 14. A 15. B 16. B 17. b

18. d 19. C 20. A 21. B 22. C 23. A 24. B 25. c

Essay Question Answers:

1. **Magnetic vs. Electrostatic Separation:**

   Magnetic Separation: Uses magnets to separate magnetic materials, such as iron and steel, from non-magnetic materials. This relies on the magnetic properties of the materials. It is commonly used for separating metals from other types of waste.

   Electrostatic Separation: Uses an electrical field to separate materials based on their ability to hold an electric charge. This depends on the electrical properties of the materials. This is commonly used to separate plastics and glass.

2. **Pyrolysis and Chemical Decomposition in Recycling:**

   Pyrolysis: A thermal process that heats materials in the absence of oxygen, breaking them down into gases, liquids, and solid residues. The resulting gases can be used as fuels, and the liquid fractions can be further refined. Pyrolysis recovers valuable fuel and chemicals from complex waste streams.

   Chemical decomposition: Employs chemical reactions with different chemical substances, to convert waste into basic raw materials for reuse or to be converted into fertilizer. This process uses chemical compounds to break down waste materials.

3. **Role of Static Electricity:**

   Benefits: Separation of materials in recycling, the charging of devices, and certain industrial processes.

   Drawbacks: Can cause shocks, may damage sensitive equipment, and requires controlled conditions

4. **Benefits and Challenges of Thermal Recycling:**

   Benefits: Can reduce landfill volumes, recover energy, and process different types of materials.

   Challenges: Potential harmful emissions, can be costly, requires high-temperature processes. To overcome these challenges new, sustainable techniques should be developed

5. **Chemical Reaction for Glass Recycling:**
   The equation shown in page 12 demonstrates this reaction. $SiO_2 + 4HCl \rightarrow SiCl_4 + 2H_2O$, where silica reacts with hydrochloric acid to produce silicon tetrachloride and water. The silicon tetrachloride can be used to produce high-purity silica, that is used in the manufacture of electronic products or other high-end materials. This process is useful in separating silica from the other components of the glass

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Lesson Three Green hydrogen as a clean fuel

In light of the increasing environmental challenges, green hydrogen is emerges as a promising clean fuel, but its production in large quantities and efficiently faces major challenges.

Living organisms play a pivotal role in this field, as some types of bacteria and algae can produce hydrogen through natural biological processes. These biological methods are characterized by their high efficiency and low environmental impact compared to traditional methods.

These organisms use light or organic matter to produce hydrogen, making them a promising option for developing sustainable energy technologies.

Therefore, investing in research and development in this field will contribute to achieving sustainable development goals and reducing dependence on traditional energy sources as the main source of energy?

Algae farming project"

"Extraction of hydrogen from algae'

Process of green hydrogen production:

Governments' efforts to produce the green hydrogen are facing several challenges:

1. The high costs of production
2. Limited renewable energy
3. The difficulty of storage.

Through which it is possible to launch from hydrogen gray and blue to green.

مجازي

Hydrogen has **colors** and is a **metaphorical** meaning that is done according to the way in which it is generated. (Hydrogen is a colorless gas from the base)

"**Green**" refers to **cleaner technologies** as not including any emissions (**zero carbon**). It can also be used as a fuel for cars directly due to its quality and purity.

"**Blue**" on the other hand, is less pure, has **10% carbon emissions** and is suitable for **industrial activities**.

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Challenge to green hydrogen production

1. Green hydrogen remains the most expensive.

Producing one ton of it **requires 61 megawatt/hr**. of renewable electricity. Thus, replacing the grey hydrogen that is currently being produced requires 36 megawatt. Equivalent to more than **60% of the total electricity** generation capacity in Egypt

2. The storage before consumption or transportation.

For storage of green hydrogen there are options, including storage in salt caves or gas fields

In Egypt, the use of exhausted gas fields to store hydrogen in the Nile Delta and Western Desert regions.

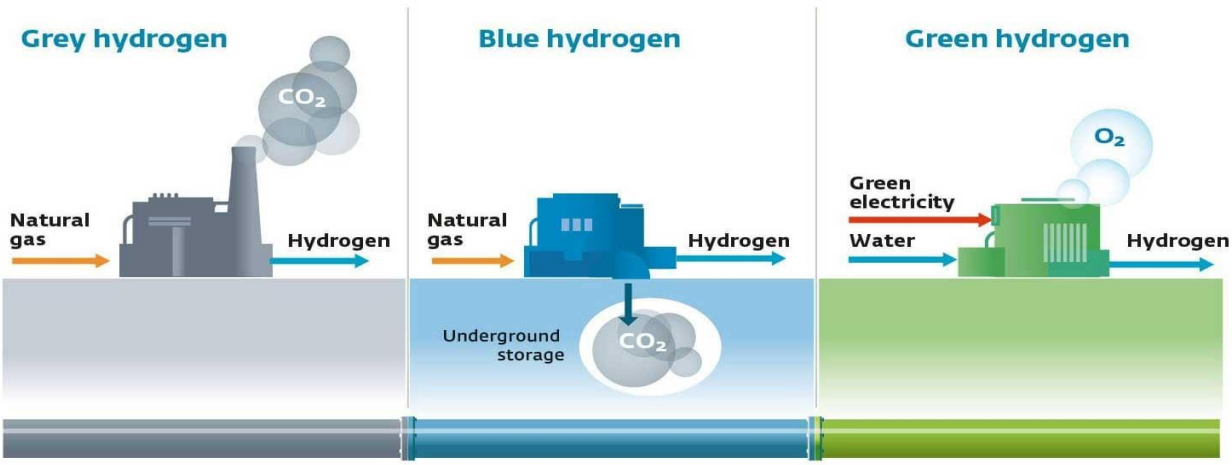
- There is no complete information about the number of salt caves, some of which are used for tourist and therapeutic purposes.

Storage in depleted wells faces a problem where hydrogen may reacts with the remaining material in these fields and release **hydrogen sulfide gas**

- Hydrogen sulfide is a **colorless**, **flammable gas** that smells like **mold**.

It is extracted from the gas associated with petroleum and is separated by heat and processed and condensed to facilitate its transportation.

It is widely used in chemical analysis



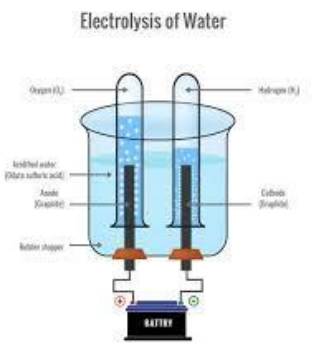
☞Production of green hydrogen

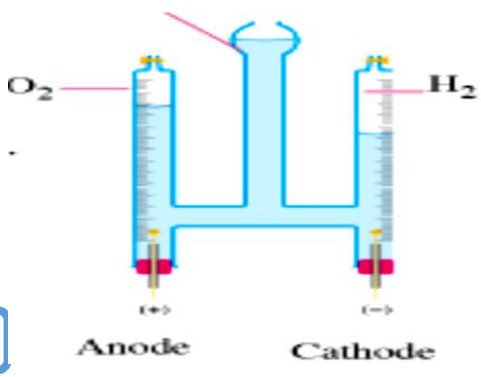
Through electrolysis of water by passing an electric current through it

Thus, water separate into hydrogen and oxygen.

$$2\ H_2O \longrightarrow 2H_2 + O_2$$

Hydrogen can be extracted from water as oxygen is released into the air





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The basic condition in this process is for the hydrogen to be green that the electricity used
in the process of electrolysis is carbon-free, i.e. the green electricity which is produced from renewable energy sources, such as water, wind and sun.

☞Production of green hydrogen by biological analysis using:

a. Bacteria

Some species such as **Clostridium** and **Enterobacter** can produce green hydrogen by decomposing organic materials in absence of air

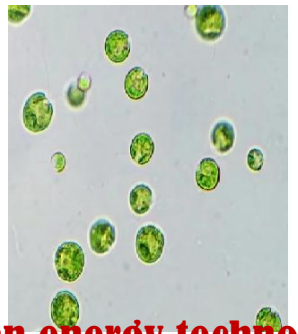
$C_6 H_{12}O_{12} \longrightarrow 6 H_2 + 6 CO_2$

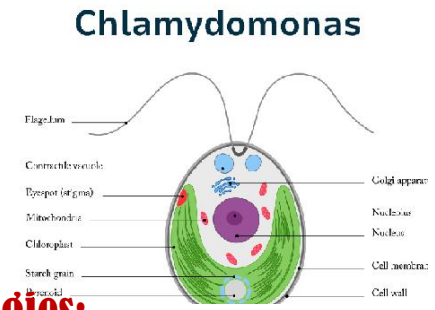
Clostridium بكتيريا

b. Algae:

Chlamydomonas can produce hydrogen using solar energy during photosynthesis.
Under certain conditions (e.g. sulphur deficiency), it can convert water to hydrogen and oxygen.

$2 H_2O \longrightarrow 2 H_2 + O_2$





☞Hydrogen applications in clean energy technologies:

A. Transportation

Hydrogen cars: Fuel-cells convert hydrogen into electrical energy, reducing fuel use and reducing carbon emissions.
Many cities have started using buses the work by hydrogen

B. Industry

Green hydrogen can be used as an alternative to natural gas in many industrial processes.
Efficiency: Hydrogen helps reduce carbon emissions from heavy industry

C. Improves air quality

The use of green hydrogen contributes to reducing air pollutants, which improves air quality in cities.

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Research and investment

The use of hydrogen as opposed to fossil fuels

Imagine a world in which cars are moving , planes are flying, and factories are powered using a clean energy that does not harm the environment. This world may not be far away, thanks to renewable energy and innovative technologies such as green hydrogen.

Fossil fuels and environmental risks

The world is still heavily dependent on fossil fuels such as oil, coal and natural gas. These sources come from land and require complex extraction processes, such as drilling and mining. But the big problem here is that burning fossil fuels produces CO_2 and other pollutants, which contribute to climate change (huge amounts of carbon dioxide) and air pollution.

Comparison of green hydrogen and fossil fuel

Green hydrogen is used in many applications, such as electric vehicle power, from heavy industry, to aircraft, while Fossil fuels are used in everything from cars to electricity generation.

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EXERCISE : Lesson three

1. Green hydrogen is produced primarily through:

   a) Burning fossil fuels b) Electrolysis of water using renewable energy

   c) Mining of rare earth elements d) Chemical decomposition of methane

2. What distinguishes green hydrogen from blue hydrogen?

   a) Green hydrogen is more expensive to produce

   b) Green hydrogen utilizes carbon capture technologies

   c) Green hydrogen is used only in aviation

   d) Green hydrogen produces zero carbon emissions

3. In the absence of _____, certain bacteria can produce hydrogen.

   a) Oxygen b) Sunlight c) Carbon dioxide d) Water

4-Which renewable source is most commonly used in water electrolysis for hydrogen production?

   a) Solar b) Tidal c) Geothermal d) Hydroelectric

4. Which industry would benefit most from switching to green hydrogen?

   a) Agriculture b) Heavy Industries c) Retail sector d) Tourism

5. Which of the following is a disadvantage of using green hydrogen?

   a) Water usage b) Energy consumption

   c) High Cost d) Environmental impact

6. What process is used to release hydrogen and oxygen?

   a) Electromagnets b) Fuel Cell c) Electrolysis d) Reforming

7. What is the primary role of methanogens in the production of energy?

   a) Convert water to methane b) Converts carbon and hydrogen

   c) Convert biomass into energy d) convert hydrogen into ammonia

8. Hydrogen production requires electricity that is

   a) Green b) Red c) Rainbow d) Blue

9. What part of alga produces hydrogen?

   a) Cellulose b) Starch c) Chlorophyll d) Chloroplast

11. Which gas is released in the air with the use of electrolysis of water?

a) Oxygen b) Carbon Dioxide c) Carbon Monoxide d) Ammonia

12. What is the primary disadvantage of producing green hydrogen on a large scale?

a) Abundance of resource b) High efficiency of current methods

c) Cost and energy demands for sustainable source of electricity

d) High rate of pollution

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13. Which is an important method of producing green hydrogen?

a) Extraction from natural gas b) Through chemical process
c) By using fuel cell d) Through water electrolysis

14. What does the use of green hydrogen aim to solve about the fossil fuels?

a) Reduce air pollution b) Reduce cost of transport
c) Reduce energy consumption d) Reduce the water usage

15. What is a potential environmental concern associated with storing hydrogen in underground locations?

a) Increased soil fertility b) Release of hydrogen sulfide gas
c) Reduced carbon dioxide levels d) Stabilization of soil structure

16. Which type of bacteria are used to produce hydrogen in the absence of oxygen?

a) Mycoplasmas b) Enterobacter
c) Rhizobia d) Methanogens

17. How can electrical power from algae be obtained?

a) By using photosynthesis b) By electrolysis with high voltage
c) By electrical storm d) By using fuel cell

18.Which natural product is needed to run the process to produce green hydrogen using biological sources?

a) Methane b) Cellulose
c) Hydrocarbons d) Ethanol

19. How can using Hydrogen help the industries?

a) Increase carbon emission b) Decrease water levels
c) Improve efficiency d) Decrease fossil fuel production

20. What is "zero carbon" to Green Hydrogen production?

a) All the process is made without fuel burn b) All waste is turned to CO_2
c) No pollutant is released d) No gases are used.

21.Why is it essential for the electricity used in water electrolysis for green hydrogen production to be carbon-free?

a) To reduce water pollution
b) To produce pure hydrogen
c) To ensure the process is environmentally sustainable
d) To increase the yield of hydrogen production

22.How can bioengineered microorganisms potentially contribute to increasing the efficiency of green hydrogen production?

a) By increasing the speed of electrolysis b) By reducing the carbon content of the water
c) By increasing the stability of the algae d) By generating hydrogen with less external energy input

23. What are the primary hurdles to be overcome in order for green hydrogen to become a widely adopted transportation fuel?

a) Lack of government subsidies
b) Inadequate transportation infrastructure and economic challenges
c) Insufficient market
d) Lack of research

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24.How does research into new storage methods for green hydrogen help to solve any problems?

a) By increasing the density of Hydrogen
b) By making hydrogen more expensive
c) By improving the reaction processes
d) By lowering the electricity used

25.Which of the following best describes the role of the Hydrogen Fuel Cell?

a) Create new hydrogen
b) Store hydrogen
c) Convert hydrogen into electricity
d) Produce carbon dioxide

Essay Questions

1. **Compare and contrast the environmental impacts of green hydrogen production via electrolysis versus the use of bacteria. Discuss the pros and cons of each approach.**
2. **Evaluate the economic viability of green hydrogen production. What factors currently limit its widespread adoption, and what technological advancements could improve its economic competitiveness?**
3. **Discuss the challenges in transportation and storage of green hydrogen**
4. **Analyze the role of governmental incentives and regulations in accelerating the transition to green hydrogen-based economies.**
5. **Explain the chemical reactions behind utilizing algae for the extraction of green hydrogen and the uses for such hydrogen**

Answer Keys

Multiple Choice Answers:

1.b 2.d 3.a 4.a 5.b 6.c 7.c 8.b 9.a 10.d 11.a 12. c 13. d 14. a 15. b 16. b 17.d 18. b 19. c 20. c 21. C 22. d 23. b 24. a 25. C

Essay Question Answers:

1. **Comparison of Electrolysis vs. Bacteria for Green Hydrogen Production:**
   - **Electrolysis: Pros: Relatively clean if renewable energy sources are used. Cons: High energy consumption, potential for some greenhouse gas emissions if the electricity grid is not fully clean.**
   - **Bacteria: Pros: Potential for even lower carbon footprint and lower energy consumption. Cons: Lower efficiency, challenging to scale up, reliance on specific organic materials.**
2. **Economic Viability of Green Hydrogen:**
   Green hydrogen is more expensive compared to the fossil fuel. Technological advancements such as high effective electrolysis and more efficient storage can be

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introduced to cut the costs. Also, government grants and incentives would help accelerate the use of the technology

3. **Challenges in Transportation and Storage:**
   - Transportation It is difficult to contain high volume of hydrogen gas in safe, energy-efficient ways
   - Storage: Hydrogen can be stored in liquid form or compressed however these methods have their own disadvantages. Hydrogen reacts with the container as well as the material is highly flammable
4. **Role of Governmental Incentives and Regulations:**
   - Incentives Can provide direct investments or help small businesses
   - Regulations: Can give more stability to the market and accelerate the production of the product
5. **Extraction of Hydrogen from Algae:**
   Algae performs photosynthesis which uses sunlight to perform electrolysis, and extract hydrogen and oxygen from H20. The Hydrogen can be collected, and converted to renewable energy source

CHAPTER 3 : Exam 1

FIRST : CHOOSE :

1. What is the primary goal of resource recycling?
   (a) To deplete natural resources faster
   (b) To reduce environmental pollution
   (c) To increase the volume of landfills
   (d) To make a profit for recycling companies
2. Which of the following is an example of mechanical recycling?
   (a) Burning waste to generate electricity
   (b) Reprocessing plastic into new products
   (c) Using chemicals to break down waste
   (d) Releasing biogas from organic wastes
3. In electrostatic separation, what property is exploited to separate materials?
   (a) Density
   (b) Magnetic susceptibility

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(c) Electrical charge
(d) Size

4. Which of the following gases is both a greenhouse gas and released during decomposition in landfills?
a) Oxygen
b) Nitrogen
c) Methan
d) Carbon dioxide

5. What is a key advantage of chemical recycling over mechanical recycling?
(a) Lower cost
(b) Simpler process
(c) Ability to handle mixed waste streams
(d) Reduced energy consumption

6. Which of the following is a common use of magnetic separation?
a) Analyzing organic material
b) Separating metallic materials
c) Separating plastics from polymers
d) Producing ammonia

7. Which of the following statements accurately describes electrolysis?
a) Electrolysis occurs spontaneously and without external energy.
b) Electrolysis uses electricity to break down chemical bonds.
c) Electrolysis consumes very little energy.
d) Electrolysis only happens with carbon

8. Which type of renewable resources can be used for the electrolysis?
a) Metal catalysts
b) Chemical substances
c) Biogas
d) Solar energy

9. In a sustainable city of the future, which energy source are more likely to use?
a) Natural gas
b) Wood
c) Green hydrogen
d) Coal

10. How do you calculate the efficiency of a solar panel?
a) Watts given off
b) By watts produced for each unit of light

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c) The color of light being used
d) Angle of solar radiation

11.How can pyrolysis contribute to the production of clean energy?

a) It generates water
b) It produces bio-oils
c) It generates salt to help the soil
d) It causes explosions

12.What is a bio refinery, and why are they so important for sustainability?

a) Refineries made by algae
b) Refining plants the transform waste into biofuel and electricity
c) Transform waste into compost
d) Transport renewable energy sources

13.How do you ensure the quality and purity of foods during magnetic separation?

a) Electric field control
b) Pressure control
c) Precise separation for meeting the standards
d) Temperature control

14.What factors determine how strong the magnetic field can be?

a) Length of solenoid coil
b) Strength of electric current
c) Number of solenoid coil turns
d) all the above

15.. If a material is being separated using electrostatic separation and is determined to be a positive charge, which electrode will it be attracted to?

a) No Electrode b) The electrode will be damaged
c) Negative Electrode d) Positive Electrode

16. Why should humidity be controlled in the electrostatic separation chamber?

a) It reduces the charge in the sample
b) It helps reduce the voltage
c) It protects the apparatus
d) It reduces the temperature

17. What does high power translate to for magnets used in mining?

a) A magnet is better for removing pollution
b) A magnet is better at removing carbon dioxide
c) A magnet is better at detecting
d) A magnet is better at simplifying extraction

18. How can humans influence the balance of the carbon cycles?

a) By reducing mining activities
b) By balancing the amount of CO_2 in the atmosphere.
c) By balancing the amount of H_2 O in the atmosphere.
d) By stabilizing temperatures in the biosphere

19. How is plastic broken down for thermal energy conversion?

a) Turned into fuel
b) It runs a cycle to be reused.
c) It's heated without air.
d) Its put into a landfill.

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20. Which statement is true about the first law of thermodynamics?

a) Energy is created
b) Energy is destroyed
c) Total energy remains constant
d) Total energy increases with use

21. What is the role of decomposers in an ecosystem, and how does this affect energy flow?

a) To increase the amount of carbon in the atmosphere
b) To prevent the transfer of energy
c) Returns the energy from dead organisms to the atmosphere
d) To recycle and return the energy in dead organisms back to the atmosphere.

22. What could be wrong with trying to apply pyrolysis to materials such as uranium?

a) Pyrolysis does not work for toxic material.
b) No reactions will happen
c) Temperature required
d) Waste is released to the atmosphere

23. How does green chemistry help with the recycling process?

a) Reduces hazardous substances in the recycling processes
b) increases hazardous substances
c) It creates a way for the product to never decompose
d) Increases water

24. What is the relationship between the source and storage of materials?

a) storage is always underground
b) storage is always made close to the extraction
c) both are very important to keep energy levels sustained
d) both cause pollution

Essay Questions (2 Questions):

1. **Compare and contrast chemical recycling and thermal recycling, highlighting their pros and cons in terms of environmental impact and economic feasibility.**

2. **Explain the importance of minimizing the environmental impact of the production of green hydrogen even when electrolysis is powered by renewable sources. What are the potential environmental concerns and what measures can be taken to address them? Answer Key (Exam 1) answer**

Multiple Choice:

1B 2b 3c 4c 5c 6b 7b 8d 9c 10b 11b 12b 13c 14d 15c 16a 17d 18b 19c 20c 21d 22c 23a 24c

Essay Questions:

1. **Chemical Recycling vs. Thermal Recycling:**

Chemical Recycling: This involves using chemical processes to break down waste into its constituent components. It offers the potential for high-quality recycled materials and processing of mixed waste streams. However, it may involve the use of hazardous chemicals and can be energy-intensive.)

Thermal Recycling: This uses high heat to convert waste into energy or other usable materials. It can handle a wider range of waste materials compared to chemical recycling, but it can result in air pollution and greenhouse gas emissions if not carefully managed

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2. **Minimizing Environmental Impact of Green Hydrogen: Even green hydrogen production can have environmental impacts. Siting of electrolysis plants, water and metal requirements. It's important to minimize these impacts.**

(Exam 2) answer

FIRSE: CHOOSE

1. **What is the primary benefit of recycling resources over incineration?**
   a) Reduce the pollution **b) Increase the waste**
   c) Decrease the amount of oxygen **d) Increase temperature**

2. **How does recycling aluminum conserve resources?**
   a) Recycling aluminum requires less water
   b) Recycling aluminum prevents new metal from being created
   c) Recycling aluminum decreases the need for aluminum extraction
   d) all of the above

3. **A high degree of control is needed to manage the electric current, this statement describes?**
   (a) Chemical Reactions **(b) Electrostatic separation**
   (c) Green Hydrogen **(d) Magnetic field**

4. **What is Biogas made out of?**
   a) Biological material **b) Carbonic material**
   c) Biological and chemical materials **d) Magnetic fields**

5. **Which statement is true?**
   a) All resources are magnetic **b) All raw materials are required for industry**
   c) All green resources don't require water **d) Recycling the materials reduces pollution**

6. **Which element is most abundant to use chemical sterilization?**
   a) Zinc **b) Sodium** **c) Copper** **d) Zinc**

7. **What is a Bio-Oil?**
   a) A new oil substitute **b) A liquid with low density**
   c) Water substitute **d) Air substitute**

8. **What cycle does not occur?**
   a) carbon cycle **b) hydrogen cycle**
   c) oxygen cycle **d) electrostatic cycle**

9. **What part of an industry uses high quantities of electricity?**
   a) Agriculture **b) Construction**
   c) Automotive **d) Mining**

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10. What is a Bio-Oil?

a) A new oil substitute b) A liquid with low density
c) Water substitute d) Air substitute

11.What is the process of using organisms to recycle organic matter?

(a) Electrical Charge (b) Electrostatic field
(c) A mechanical field (d) biochemical reactions

12. In the "City of Tomorrow," what problem was addressed?

a) A lack of space b) A lack of water
c) Difficultly disposing of waste. d) There was too much CO2.

13. Which of the following techniques will prevent the formation of hazardous substances?

a) Recycling with chemicals b) Electrolysis
c) Chemical sterilization d) Waste disposal

14. What natural compound helps in getting rid of chemical waste?

a) Hydroxides b) Water
c) Oxygen d) Salt

15. What does the symbol Biogas stand for?

a) The recycling process b) The process for obtaining fuel from biological substances
c) Sterilizing bacteria d) Creating a new chemical

16. What must humans be concerned with when performing thermal recycling?

a) The size of container b) The temperature range
c) The waste from burning off all the pollution d) The pollution caused by the material.

17.What happens to the energy that is lost?

a) Creates friction b) Stored in new bond
c) Gets stored in the oceans. d) Transforms into other forms

18.What material helps in extraction processes?

a) Gold catalyst b) Cyanide
c) Copper d) Silver

19.What causes electrolysis to be efficient?

a) High heat b) Renewable source of electricity
c) Electrolyte d) Clean water

20.What industry uses Aluminum?

a) Automotive b) Transport
c) Aerospace d) all the above

21. Why is it important to consider the life cycle of a product when discussing recycling and sustainability?

a) So that there is waste
b) So that we ensure it can continue to produce products
c) So that we reduce the waste and ensure reuse at each step
d) So that we can destroy everything

22. Which of the following is a key consideration when evaluating the environmental impact of chemical recycling processes?

a) The cost of the initial chemical investment.

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b) The potential for pollution from the process.
c) The availability of skilled labor.
d) The potential for increased carbon emissions.

23. What is the role of government and businesses in promotion of renewable sources of energy?

a) Help with logistics b) Financial incentives
c) Educate the people d) all the above

24. If the amount of CO2 in the atmosphere is stable, how would the green house gasses increase?

a) Humans can stop releasing greenhouse gasses
b) The Sun would begin releasing higher amounts of radiation
c) The Sun would absorb more radiation
d) The Sun would have to grow weaker

25. Which is something that requires to have control?

a) Electric circuit b) Biological materials
c) Chemical reaction d) Natural resources

Essay Questions (5) Questions):

1. Discuss the challenges associated with balancing the benefits of recycling with the potential negative impacts, such as pollution from recycling processes .
2. Describe the potential of chemical sterilization techniques to improve the health of a city
3. What are the environmental concerns about the use of chemicals that occur during the mining process
4. How is reusing certain materials cheaper
5. Evaluate the role of public awareness and education in promoting successful resource management and sustainable recycling p

Answer Key (Exam 2)

Multiple Choice:

1. A 2. c 3. B 4. A 5. d 6.c 7. C 8.d 9. A 10. b 11. b 12. d 13. a 14. c 15. b 16. d 17. d 18. b 19. a 20. a 21. b 22. a 23. d 24. c 25. d

Essay Questions

1. Balancing Recycling Benefits and Negative Impacts: Careful selection of recycling methods, investment and public involvement.
2. Chemical Sterilization to Improve the Health of a City: Benefits of chemical sterilization can control and eliminate certain health factors and problems.
3. Environmental Concerns about the chemicals during Mining: Damage and contamination of land, harm to people and animals.
4. Explanation for Reusing certain materials in cheaper process: The savings involved, lower costs.

The Role of Awareness: Education is k

Chapter Four The Future of Energy

Lesson One Biotechnology in energy development

Biotechnology is a scientific field that deals with the use of organisms or their components to achieve specific goals. This includes applications in medicine, agriculture, and industry. One of the innovative applications is the use of biotechnology to convert living organisms into energy sources.

Bioenergy: the energy derived from living organisms such as plants and animals. They are characterized by being renewable and environmentally friendly.

How organisms are used in energy production?

A. Biodegradation

Biodegradation: the process of converting organic materials (such as waste) into energy using living organisms such as bacteria.
This process occurs naturally or is artificially controlled in waste storage areas that produce methane gas that can be used as an energy source.
- The following is an explanation of the main steps for biodegradation with equations:

Step 1: Hydrolysis

In this first phase, bacteria break down complex organic substances (such as carbohydrates, proteins, and fats) into simpler units such as sugars, amino acids, and fatty acids.
For example, starch (carbohydrates) is broken down into glucose:

$$(C_6H_{12}O_6)_n + H_2O \longrightarrow nC_6H_{12}O_6$$

Step 2: Fermentation Sorrel (Acidogenesis)

In this mixture, acidic bacteria convert sugars and amino acids produced by primary hydrolysis into short-chain fatty acids or alcohols, with producing gases such as carbon dioxide and hydrogen.

Step 3: Acetic acid production

Bacteria carry out an additional process to convert fatty acids, alcohols or gases produced in the previous step into acetic acid, hydrogen, and carbon dioxide.

Step 4: Methane Production (Methanogenesis)

In this final step, melthanogene bacteria convert acetic acid or carbon dioxide and hydrogen into methane (CH_4) and water.

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This is the most important step in the production of biogas energy.

$$CH_3COOH_6 \longrightarrow CH_4 + CO_2$$
$$CO_2 + 4H_2 \longrightarrow CH_4 + 2H_2O$$

B. Biofuels

Biofuels are a type of energy sources produced from living organisms such as plants or algae. This includes ethanol and biodiesel

Chemical processes of biofuel composition:

A. Production of bioethanol

Fermentation:

- The production of bioethanol begins with the conversion of starchy or sugary substances into simple sugars (such as glucose) through hydrolysis.
- Then fermentation of these sugars using yeast to produce ethanol C_2H_5OH and CO_2

$$C_6H_{12}O_6 \xrightarrow{\text{Yeast}} 2CO_2 + 2\ C_2H_5OH$$

B. Biodiesel production:

In this process, vegetable oils or animal fats (containing tertiary glycerides) are reacted with alcohol (usually methanol or ethanol) in the presence of a catalyst, such as sodium hydroxide (NaOH).

$$C_xH_yOH + \text{Oil} \xrightarrow{\text{Catalyst}} \text{Biodiesel} + \text{Glycerin}$$

Questions

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Multiple Choice Questions on Biotechnology in Energy Development

1-What is bioenergy?

a) Energy derived from fossil fuels
b) Energy derived from living organisms
c) Energy generated from nuclear reactions
d) Energy from geothermal sources

2-Which process converts organic matter into energy using microorganisms?

a) Photosynthesis
b) Biodegradation
c) Fermentation
d) Combustion

3-What is the primary product of methanogenesis?

a) Ethanol
b) Methane
c) Glycerin
d) Hydrogen

4-What is the first step in the biodegradation process?

a) Acidogenesis
b) Hydrolysis
c) Acetic acid production
d) Methanogenesis

4-Which type of bacteria is involved in the production of methane?

a) Acidophilic bacteria
b) Methanogenic bacteria
c) Lactic acid bacteria
d) Fermentative bacteria

5-What is a major byproduct of bioethanol production?

a) Methane
b) Glycerin
c) Carbon dioxide
d) Oxygen

6-Which of the following is NOT a biofuel?

a) Ethanol
b) Biodiesel
c) Natural gas
d) Methanol

7-What is the main raw material used for bioethanol production?

a) Animal fats
b) Sugar or starch
c) Coal
d) Natural gas

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8-What chemical process is primarily used in biodiesel production?

a) Hydrolysis
b) Combustion
c) Transesterification
d) Fermentation

9-What is the role of yeast in bioethanol production?

a) To produce methane
b) To ferment sugars into ethanol
c) To convert fatty acids into glycerol
d) To break down cellulose

10-Which of the following is a benefit of using biofuels?

a) They are always cheaper than fossil fuels
b) They can reduce greenhouse gas emissions
c) They do not require any land to grow crops
d) They are non-renewable resources

11-What is a challenge associated with large-scale biofuel production?

a) Abundance of raw materials
b) High costs and competition for land
c) Low demand for biofuels
d) Lack of technology

12-Which of the following is a product of the fermentation process?

a) Methane
b) Ethanol
c) Glycerin
d) Acetic acid

13-What is the primary advantage of biofuels over fossil fuels?

a) Higher energy density
b) Renewable and less polluting
c) Lower production costs
d) Longer shelf life

14-What is produced as a by-product during biodiesel production?

a) Methane b) Glycerin c) Ethanol d) Carbon dioxide

15-Which of the following materials can be converted into biodiesel?

a) Coal b) Vegetable oils c) Natural gas d) Wood

16-What is the main chemical reaction involved in biodiesel production?

a) Combustion
b) Transesterification
c) Fermentation
d) Hydrolysis

17-What type of energy does biomass represent?1

a) Non-renewable

Integrated Sciences for 1st secondary

b) Renewable
c) Nuclear
d) Geothermal

18-Which of the following is a major source of bioethanol?

a) Algae
b) Corn and sugarcane
c) Coal
d) Natural gas

19-What is the result of hydrolysis in biofuel production?

a) Production of alcohol
b) Conversion of complex materials to simple sugars
c) Generation of methane
d) Creation of carbon dioxide

20-What is a common catalyst used in biodiesel production?

a) Sulfuric acid
b) Sodium hydroxide
c) Ammonia
d) Ethanol

21-Which process involves the breakdown of organic matter by microorganisms?

a) Hydrolysis
b) Biodegradation
c) Distillation
d) Fermentation

22-What is the primary method for producing bioethanol from biomass?

a) Fermentation
b) Transesterification
c) Combustion
d) Distillation

24-What is the main environmental benefit of using biofuels?

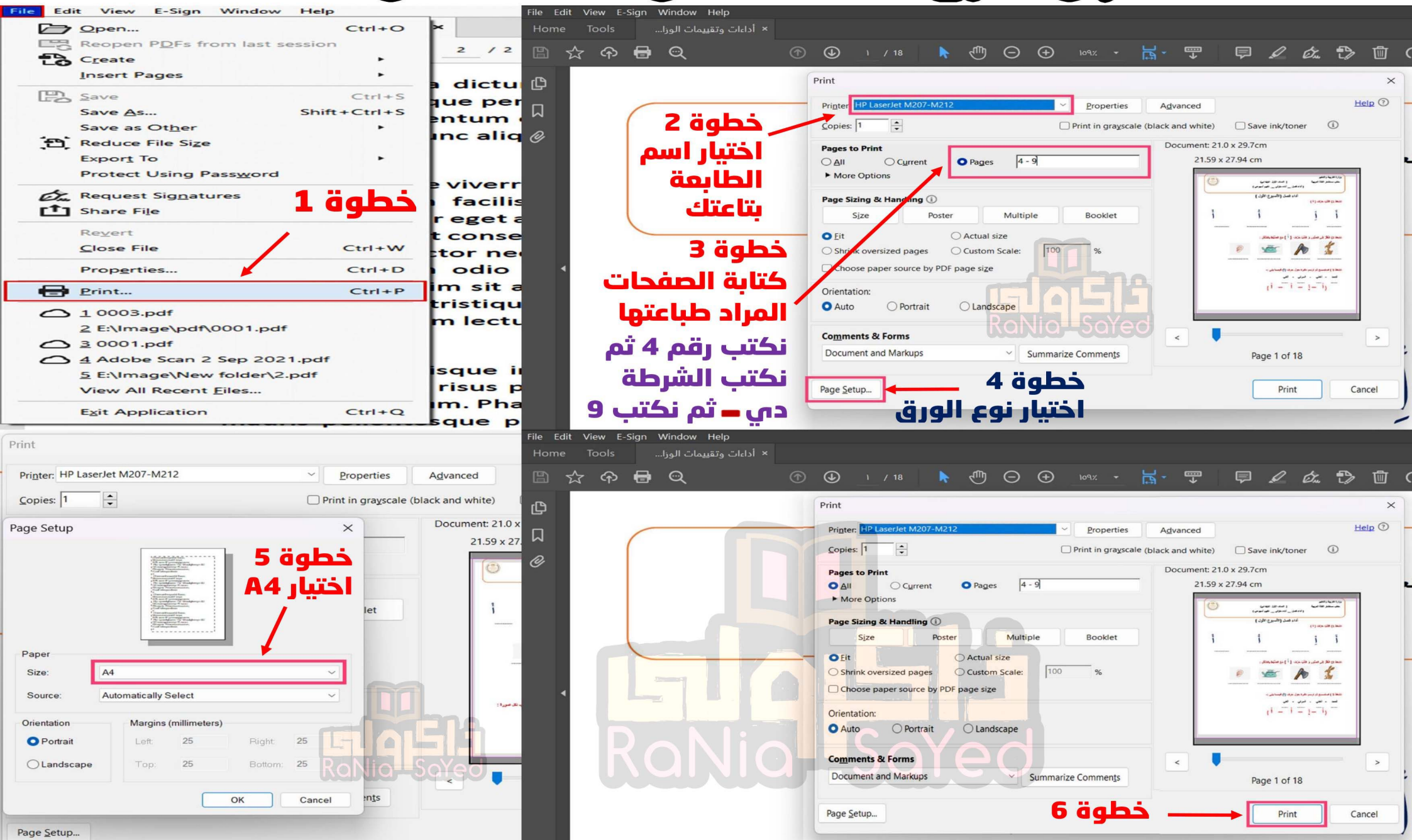
a) They are always cheaper
b) They do not require land
c) They help reduce carbon emissions
d) They increase energy consumption

25-What type of biomass can be converted into biofuels?

a) Only wood
b) Algae, crops, and waste
c) Only animal waste
d) Only agricultural residue

كيفية طباعة صفحات معينة من ملف معين

مثلا ازاى نطبع الصفحات من صفحة 4 الى صفحة 9



المراجعة رقم (2)

اختبار شهر مارس

Chapter Two
Lesson 2: Chemistry and Mining

Get Ready!!!

- Review of natural resources: such as minerals, oil, coal, and others.
- The importance of these resources in meeting daily needs.
- The effects of excessive use on the environment and the importance of managing the resulting waste.

Depletion of Natural Resources

- It is the consumption of resources at a rate that exceeds their ability to regenerate.

Impacted resources include

fossil fuels, minerals, water, soil, and biodiversity.

Impacts include:

ecosystems, public health, and economies.

Example: Mining is the process of extracting minerals from the earth.

Environmental impacts:

- Removal of soil layers, affecting temperature and humidity.
- Air and water pollution.
- Soil erosion and land degradation.
- Underground mining creates voids that lead to ground collapse or the formation of pits.

Other impacts:

- **Land structure change:** Removal of upper layers causes land erosion and destruction of natural habitats.
- **Chemical pollution:** Chemicals may seep into groundwater, altering its physical properties and affecting aquatic environments.

Chemistry and Mining

Chemistry is linked to the processes of extracting, refining, and using minerals in various industries. This includes:

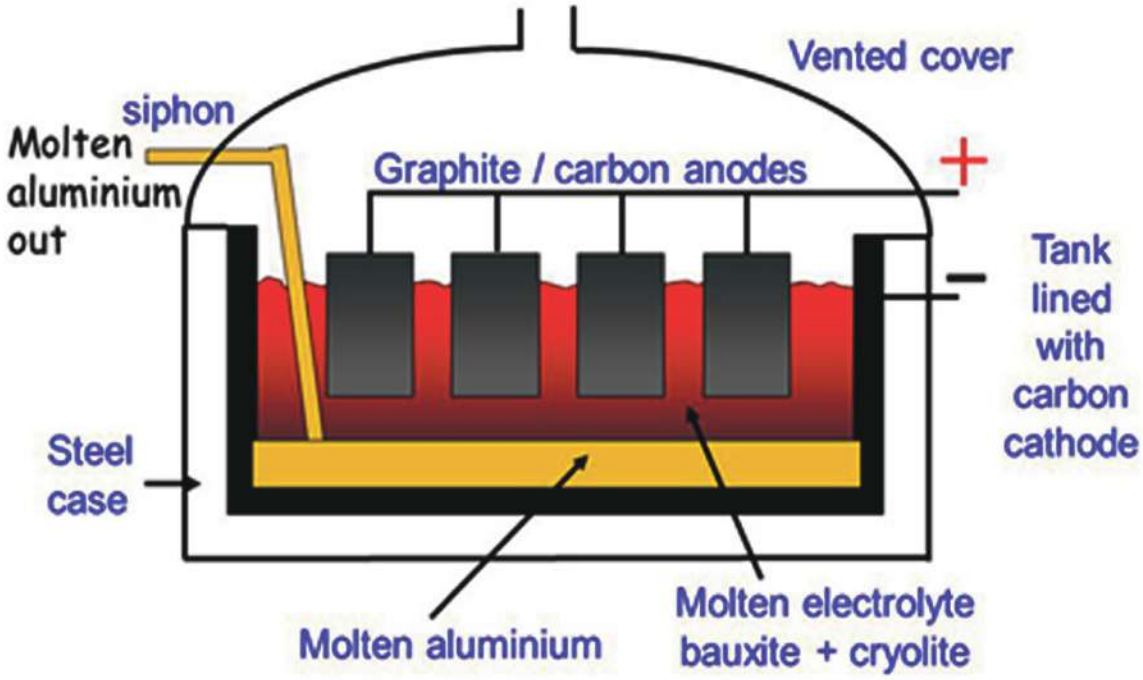
1 Chemical analysis of ore

The ore is analyzed using chemical techniques to determine the type and quantity of the mineral, which helps in evaluating the feasibility of the mining process.

2 Extraction of minerals

a Extraction of aluminum from bauxite ore:

Aluminum is extracted from bauxite ore (Al_2O_3) dissolved in cryolite (Na_3AlF_6) through an electrolytic process in the electrolytic cell as shown in the diagram.

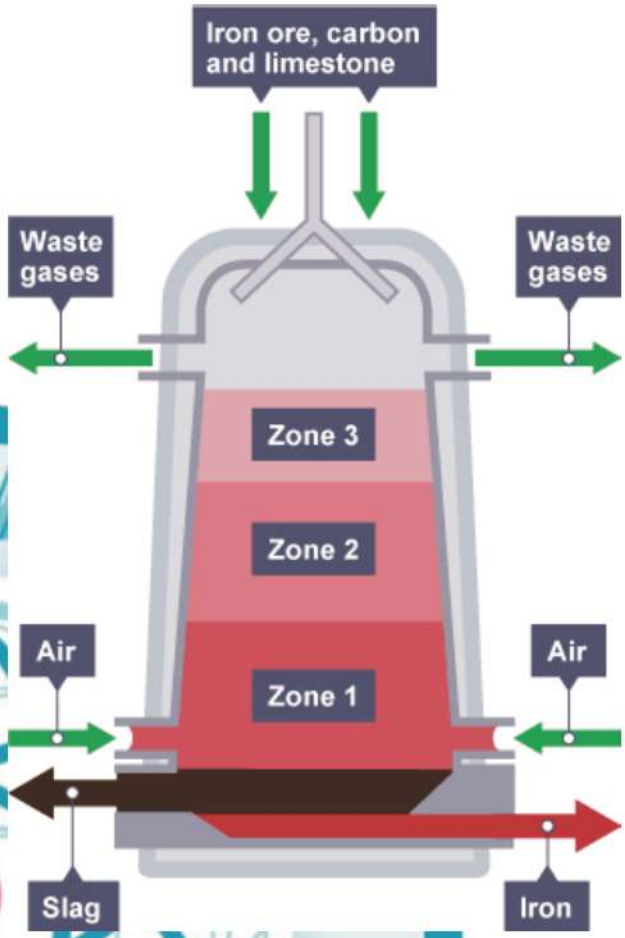


- **Aluminum extraction equation:**

$$2\,Al_2O_3 \longrightarrow 4\,Al + 3O_2$$

b Extraction of iron from hematite:

Iron is extracted from hematite ore in a blast furnace using coke, which reacts with oxygen to produce carbon monoxide, the reducing agent that extracts iron in its molten form.



c Extraction of gold using cyanide:

Cyanide is used to extract gold from its ores by dissolving it in a sodium cyanide solution. Gold is then separated using activated carbon or other methods.

Gold extraction equation:

$$NaOH4 + Na(Au(CN)_2)4 \longrightarrow H_2O2 + {}_2O + NaCN8 + Au\ 4$$

Mineral Purification

After extracting minerals, they need purification processes using electrolysis (such as copper purification) or chemical agents to remove impurities.

Environment and Mining

Chemistry contributes to reducing the environmental impact of mining by developing methods to treat polluted water and dispose of waste safely.

Disposal of Chemical Waste

Classification and Separation:

Waste is classified according to its type and danger level (e.g., flammable, toxic, radioactive).

Temporary Storage:

Waste is stored in safe, leak-resistant containers with clear warning labels.

Treatment:

Waste is treated to reduce its toxicity or convert it into less hazardous materials using acids or bases and oxidation or reduction processes.

FinalDisposal: This includes:

- **Landfill Disposal:** Waste is buried in specially designed landfills with sealing layers.
- **High-Temperature Incineration:** Some waste is burned to reduce its volume and eliminate toxicity.
- **Recycling:** In some cases, chemical solvents can be purified and reused.

MonitoringandFollow-Up:

Monitoring final disposal sites to ensure no environmental contamination occurs, using techniques like chemical precipitation or filters to remove heavy metals from wastewater.

Research and Investigation

Task:

Explore the impact of natural resource depletion by studying the effects of deforestation and mining on the ecosystem.

Steps:

1. Choose an area suffering from deforestation or mining.
2. Collect data on biodiversity loss, soil quality, and water quality in the area.
3. Compare the results with another area unaffected by human activities.

Chapter Two
Lesson 3: Renewable Energy

Get Ready!!!

- Imagine you are walking on a sunny day, wishing you could make better use of this renewable energy. Or perhaps you notice the strong winds outside and think about how to convert them into energy.
- In this lesson, we will learn about different types of renewable energy, how to harness them, and assess their impact on the environment and climate. Let's begin exploring these natural energy sources and how to convert them into energy for effective use.

Renewable Energy Examples

Renewable energy is energy that naturally replenishes in a short time.


Wind


Solar

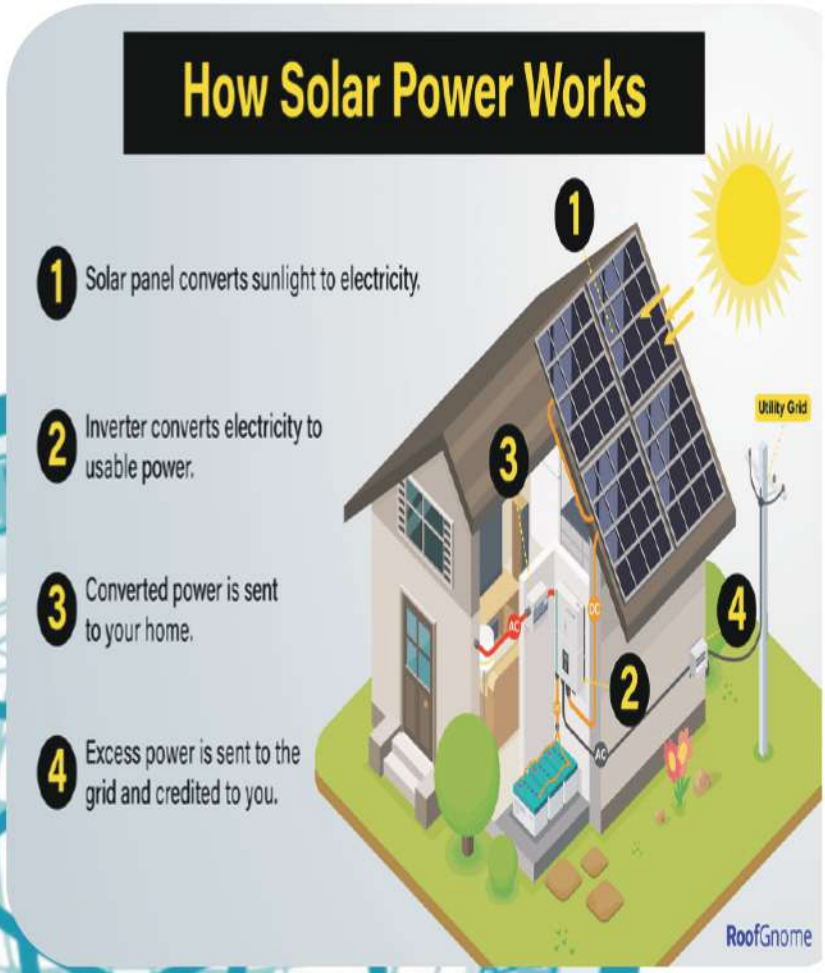

Geothermal


Hydro


Biomass


Tidal

First: Solar Energy



Solar Cells:

These are made of semiconductors that convert solar energy directly into electrical energy and are considered modern means of energy generation.

Importance:

They help preserve the environment and reduce pollution caused by fossil fuels.

How They Work:

When light falls on the surface of a semiconductor material like silicon, electrons are displaced to one of the surfaces, creating a voltage difference that can generate an electric current when connected to an external circuit.

Solar Cell Efficiency:

Efficiency is measured by comparing the generated electrical energy to the incident solar energy.

Efficiency Factors

It depends on factors such as the angle of light incidence, clouds, dust, and humidity. It can be improved using technologies like nanotechnology.

- **Calculating Electrical Energy:**

Electrical energy (E) in joules is calculated using the formula:

$$E = V \times I \times t$$

- Where I is the electric current in amperes **(A)**, **V** is the voltage difference in volts **(V)**, and t is the time the electric current passes in seconds (s).
- In practical applications, it is preferred to work with power **(P)**, measured in watts **(W)**, which represents the energy produced or consumed in one second. It is calculated using the formula:

$$P = I \times V$$

$$\text{Solar cell efficiency} = \frac{\text{Output electrical power}}{\text{Incident optical power on the cell}} \times 100$$

- **Example:** A solar panel generates a voltage difference of 10 V, and a current of 0.5 A flows when an electrical circuit is connected to it. Calculate the electrical power it produces.

Solution

Think:

If you have a solar cell installed on the roof of your house, and this solar cell operates at an efficiency of %20, meaning it converts 20% of the solar energy it receives into electrical energy.

1. If the sunlight provides 1000 W/m^2 of solar energy on the surface of the cell, what is the amount of electrical energy produced by the solar cell per square meter?
2. If the area of the solar cell is 2 m^2 , what is the total electrical power produced by the panels?
3. How can the electrical power output from solar cells be increased?
4. If the area of the solar cell is 2 m^2 , what is the total electrical power produced

Second: Wind Energy

Wind energy relies on converting the movement of air into clean electrical energy using wind turbines, which consist of slanted blades, turbines, and electrical generators.

How it works:

The blades attached to the turbines generate mechanical movement when air passes through them, which is then converted into electrical energy by the generators.

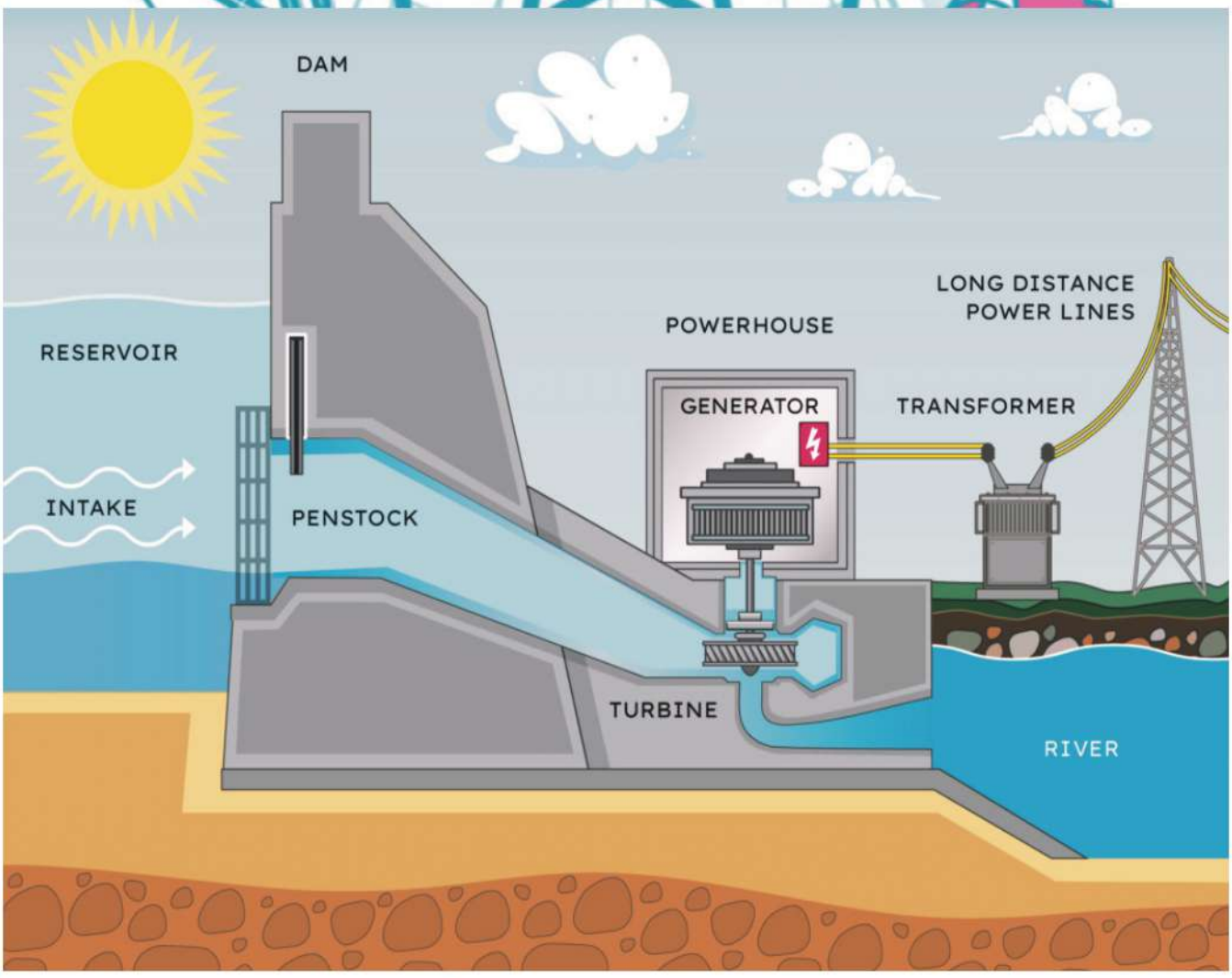
Location of turbines:

It is preferable to build turbines in open areas like deserts and elevated regions (Why?) to increase efficiency due to higher wind speeds.

Third: Hydropower Energy

This relies on using dams to store water, which gains potential energy. The dams have gates that control the flow of water from the top to the bottom.

How it works:

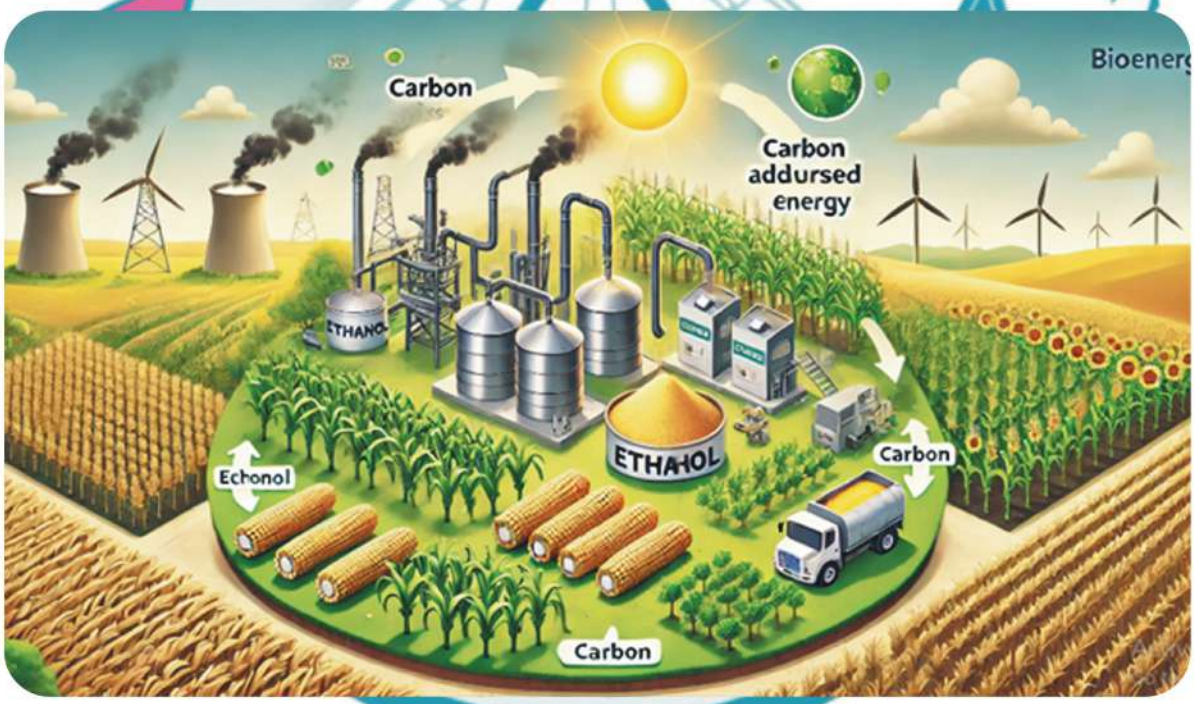


Fourth: Biomass Energy

- Biomass energy is produced from organic materials such as plants and animals, and is converted into biofuels (like ethanol and biodiesel) or electricity through combustion.

Example:

- Crops like corn and sugarcane are used to produce ethanol, a fuel that serves as an alternative to gasoline.
- Crop residues and agricultural waste can be used to generate energy through fermentation or combustion.
- Biomass energy helps reduce carbon emissions compared to fossil fuels, as the carbon released during the combustion of biomass fuel was previously absorbed from the atmosphere by plants.



Research Activity

Research the impacts of renewable energy on the environment and climate change.

Scientific Activity

- Conduct a simple experiment using small solar cells to measure the amount of electricity that can be generated from sunlight at different times of the day.
- Record the results and analyze them to determine the best times to take advantage of solar energy.

Chapter Two

Lesson 4: Applications of Renewable Energy in Daily Life

Get Ready!!!

Have you ever wondered how using renewable energy impacts your daily life? Perhaps you have noticed solar panels on rooftops or seen wind turbines spinning at wind farms. **In this lesson**, we'll explore how renewable energy is converted into electricity and how it's used in our everyday lives. We will analyze the effectiveness of these technologies in reducing carbon emissions and examine their environmental impact through chemical interactions.

Using Living Organisms to Produce Renewable and Sustainable Energy

Green Biotechnology: An Innovative Field Combining Biology and Technology

The use of living organisms to produce renewable energy is an innovative field that merges biology and technology to create sustainable energy sources. This field leverages the natural biological processes occurring in living organisms.

Enhancing the Use of Natural Resources

Research and development in this area contribute to maximizing the use of natural resources in ways that preserve the environment and support global energy goals.

Using Biomass for Energy Production

- Agricultural waste, such as rice straw, or specific plants, like sugarcane, can be used to produce energy.
- These processes involve fermentation and anaerobic decomposition, helping to reduce reliance on fossil fuels.

New Opportunities from Microalgae and Microorganisms

Microalgae and microorganisms offer new opportunities for producing biofuels through advanced biological processes, such as converting organic materials into electrical energy or liquid fuel.

Introduction to Renewable Energy from Living Organisms

The use of living organisms to produce renewable energy is an innovative field that combines biology and technology to create sustainable energy sources.

This type of energy relies on utilizing the natural biological processes occurring in living organisms. Research and development in this field enhance our ability to use natural resources in an environmentally friendly way while supporting global energy goals.

1 Sources of Energy from Living Organisms:

- **Biomass:** Agricultural waste, such as rice straw, or specific plants like sugarcane, can be used to produce energy through processes like fermentation and anaerobic decomposition, reducing reliance on fossil fuels.
- **Microalgae and Microorganisms:** Microalgae and microorganisms offer new opportunities for producing biofuels through advanced biological processes, such as converting organic materials into electrical energy or liquid fuel.

2 Types of Organisms Used in Energy Production

- **Methane-Producing Bacteria:** These bacteria can break down organic materials in waste treatment plants or livestock farms, producing methane as a biofuel.
- **Enzymes:** Enzyme-based energy is an innovative development in renewable energy. Enzymes can convert plant cellulose into sugars that can then be transformed into ethanol. They can also facilitate the conversion of fats into biodiesel using specific enzymes.
- **Microalgae:** Microalgae are considered a promising future solution for biofuel production. They can be cultivated in controlled environments to produce oils that are converted into biodiesel.

3 Other Biological Sources of Energy

- **Energy from Plants:** Plants can be converted into biofuels through processes like fermentation and decomposition to meet energy needs. Aquatic plants, such as water hyacinth and algae, are used to produce biodiesel or ethanol.
- **Marine Algae:** Marine algae, which grow rapidly in saltwater, can be used to produce biofuels without requiring agricultural land.
- **Phototrophic Bacteria:** Phototrophic bacteria utilize light to convert carbon dioxide and water into biofuels, such as ethanol or hydrogen.

Aquaticplants

MarineAlgae

Phototrophic Bacteria

Examples of Household Devices Powered by Solar Energy

Solar Water Heaters:

Solar water heaters are used to heat water at home, reducing reliance on electric heaters and helping save electricity.

Solar-Powered Air Conditioners:

Solar-powered air conditioners are suitable for hot regions, as they help reduce electricity consumption in homes.

Solar Lamps:

These lamps are used to illuminate and decorate gardens and serve as an alternative to traditional lighting during power outages. They are environmentally friendly.

Chapter Three

Lesson 1: Patterns of Resource Recycling and Utilization

Get Ready!!!

- Resource Recycling is the process of reusing materials that have already been used, transforming them into new products instead of discarding them as waste.
- This process plays a vital role in achieving sustainable development by reducing the pressure on natural resources and minimizing environmental pollution. Let's explore some methods of resource recycling and their benefits to the ecosystem.

Methods of Resource Recycling and Their Benefits to the Ecosystem

1 Mechanical Recycling

This is the most common method worldwide. It involves collecting non-degradable material residues and reintroducing them into the same industry to go through the same manufacturing processes again, resulting in a product of the same type.

2 Energy Recycling

This method is used for plastic residues, where they are converted into electrical or thermal energy through combustion, transforming the plastic into fuel.

Example: Recycling aluminum saves about 95% of the energy required to produce aluminum from bauxite.

- The recycling process takes place in electrolysis cells, which demand high electrical energy. In contrast, recycling involves simply melting down consumed aluminum and reshaping it, requiring significantly less energy.

Note:

Despite the significant benefits of energy recycling, it is important to consider its negative aspects, such as air pollution resulting from waste burning. Therefore, more sustainable technologies must be developed.

Example: If producing one ton of aluminum from raw materials requires 15,000 kilowatt-hours, recycling the same amount requires only 750 kilowatt-hours.

Solution

Calculating Saved Energy

Saved Energy = Energy Used in Original Production - Energy Used in Recycling

3 Chemical Recycling

This method involves using chemicals added to waste to recover basic materials or to break down biological residues for producing biogas.

a Thermal Decomposition:

A chemical process conducted at high temperatures in the absence of oxygen, where organic waste is broken down into simpler components, such as gas, low-density liquids like bio-oils, and solid materials.

Examples:

- **E-Waste Decomposition:** Chemicals such as acids are used to separate valuable metals like gold and copper from electronic waste.
- **Expired Drug Decomposition:** Acids or bases are used to break down old medicines into harmless compounds.

b Chemical Sterilization:

This involves chemical reactions to neutralize toxic or harmful substances in waste, such as:

- Neutralizing reaction: In chemical waste, acids or bases can be neutralized with counter substances like sodium carbonate or sodium hydroxide.

  Example: The reaction of hydrochloric acid with sodium hydroxide produces salt and water.

- **Medical Waste Treatment:** Chemicals like chlorine or ozone are used to treat medical waste, eliminating bacteria and viruses.

4 Biochemical Interaction

This method uses living organisms or enzymes to convert organic waste into usable materials, such as turning organic waste into compost.

Examples:

- **Biological Decomposition:** Organic waste, such as food leftovers, can be transformed into organic compost through chemical reactions facilitated by microorganisms.
- **Converting Waste into Biofuel:** Specific bacteria can convert organic waste into biofuels such as ethanol.

The Impact of Recycling on Maintaining Environmental Balance

1. **Recycling One Ton of Paper:** Recycling a single ton of paper saves 17 trees, %70 of the energy, and 85% of the water required to produce new paper.
2. **Environmental Impact:** By recycling all newspaper paper, we can reduce carbon dioxide emissions by 20 million tons annually—equivalent to removing 5 million cars from the roads.

Research and Exploration: The Sustainable City of the Future

By 2050, imagine living in a city entirely reliant on renewable energy sources and advanced recycling technologies. This city serves as a model for environmental conservation and sustainable resource utilization. Its key features include:

1. Dependence on Renewable Energy:

The city meets all its energy needs through renewable sources like solar, wind, and geothermal energy.

2. Advanced Resource Recycling:

All waste is transformed into reusable materials through advanced chemical and physical technologies. No waste is sent to landfills; everything is recycled to create new products.

3. Chemical Recycling Technologies:

Factories employ chemical recycling technologies to convert plastics, metals, and glass into new materials. These technologies reduce the depletion of natural resources and minimize environmental pollution.

Challenges and Opportunities

- **The Biggest Challenge:** Plastic Waste: Plastics pose a significant challenge due to their difficulty in decomposing naturally. Using innovative technologies to chemically break down plastics, they can be converted into basic components for new, reusable materials.
- **The Role of Research and Development:** You are part of a research team specializing in evaluating the efficiency of chemical recycling techniques for plastics compared to traditional methods. The team is also working on developing new methods to enhance the recycling processes for aluminum and glass using these technologies.

Key Discussion Points

1 **Environmental and Resource Conservation:** Recycling helps reduce excessive consumption of natural resources, thereby preserving habitats and ecosystems.

2 **Reduction in Resource Extraction:** Recycling reduces the need for resource extraction, thereby mitigating the environmental impacts of mining and deforestation.

3 **Reduction in Environmental Pollution:** Recycling lowers environmental pollution, which can negatively impact wildlife and surrounding ecosystems.

Chapter Three

Lesson 2: Resource Recycling Techniques and Their Impact on the Environment

Get Ready!!!

- Imagine you have a box filled with a mixture of different materials like iron, plastic, and glass. How can you separate these materials and recover each one for reuse?
- In this lesson, we will explore modern techniques used in resource recycling and how these techniques impact the environment. We will learn about methods such as magnetic separation and electrostatic separation, as well as how chemical reactions contribute to material reprocessing. Let's embark on this journey into the world of technologies that help preserve our planet.

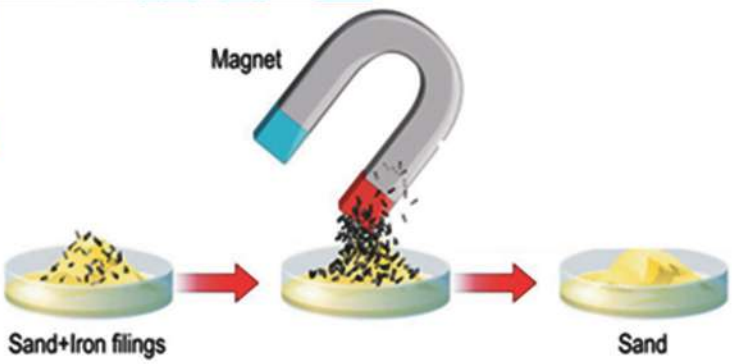
Modern Techniques in Resource Recycling

Modern resource recycling techniques rely on advanced chemical and physical processes to transform waste into reusable materials, reducing the depletion of natural resources and minimizing environmental pollution. These techniques promote sustainability and contribute to a circular economy.

1 Magnetic Separation

Definition:

Magnetic separation relies on the use of a strong electromagnet to separate magnetic materials from other substances.



Working Mechanism:

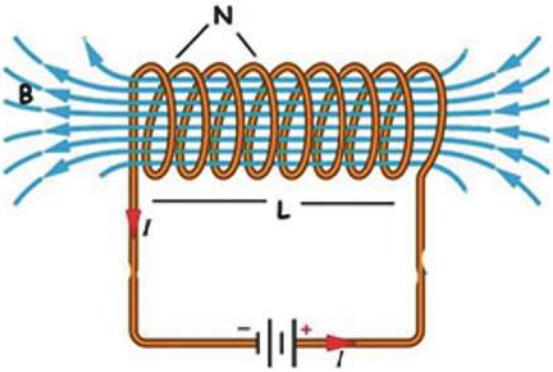
An electric current is passed through a copper coil wrapped around a soft iron core, turning the core into a temporary magnet that attracts surrounding magnetic materials.

Calculating Magnetic Flux Density

$$\therefore B = \frac{\mu N I}{L}$$

Where:

- **B: Magnetic field density (Tesla)**
- **N: Number of turns in the coil**
- **I: Electric current (Amperes, A)**
- **r: Radius of the coil (meters, m)**
- **L: Length of the solenoid (meters, m)**
- **μ: Magnetic permeability (T.m/AT)**



Example: A solenoid with a length of 3.2 cm consists of 90 turns. A constant current of 1.2 A flows through the wire. Calculate the magnetic flux density at the center of the solenoid.

Solution

Applications of Magnetic Separation and Its Role in Energy Recycling

A) Recycling:

Separating metals from waste based on their magnetic properties.

B) Environmental Cleaning:

Removing magnetic pollutants from water and soil.

C) Food and Pharmaceutical Industries: Ensuring product purity.

D) Mining: Extracting metals from raw ores.

E) Chemical and Petrochemical Industries: Purifying raw materials and removing impurities.

F) Electronics: Recovering precious metals from electronic waste.

G) Automobile Industry: Separating iron and steel from old cars to facilitate recycling.

2 Electrostatic Separation

Introduction:

Static electricity is a physical phenomenon caused by an imbalance of electric charges within or on the surface of a material. When a material loses electrons (negatively charged particles), it becomes positively charged, and vice versa. This charge remains stationary until a discharge occurs.

How is static electricity generated?

Static electricity can result from several factors, including:

a. **Friction:** When two objects are rubbed together, electrons transfer from one to the other, charging both objects oppositely (e.g., rubbing a balloon on hair).

b. **Contact:** When a charged object touches a neutral one, electrons transfer between them, charging the neutral object.

c. **Induction:** When a charged object is brought near a conductor, charges redistribute in the conductor, with opposite charges gathering near the charged object.

Examples of Static Electricity in Everyday Life:

a. **Electric shock when touching a metal doorknob:** Caused by charge buildup on the body due to friction with clothing.

b. **Hair attracted to a plastic comb after brushing:** Due to electron transfer from hair to the comb.

c. **Balloon sticking to a wall after being rubbed on hair:** Due to electrostatic attraction between opposite charges.

Mechanism of Electrostatic Separation:

- Electrostatic separation involves exposing a mixture of particles to an electric field, which charges particles differently based on their properties.
- Charged rods with opposite charges repel particles of the same charge and attract particles of the opposite charge, enabling separation.

Advantages and Disadvantages of Electrostatic Separation

Advantages:

Allows separation of large mixtures of materials with similar shapes and sizes but different electrical properties.

Disadvantages:

Requires precise control of electrical current, humidity, and temperature, as these factors significantly impact the process.

Examples of Materials That Can Be Separated:

- **Plastics and Metals:** Separate plastics like polyethylene from metals like aluminum in an electric field.
- **Plastics and Glass:** Separate plastics such as PVC from glass.
- **Wheat and Metallic Impurities:** Separate grains like wheat from metallic contaminants.

3 Thermal Recycling

Definition:

A process of reusing materials by heating solid or liquid waste to high temperatures to extract energy or convert them into reusable materials.

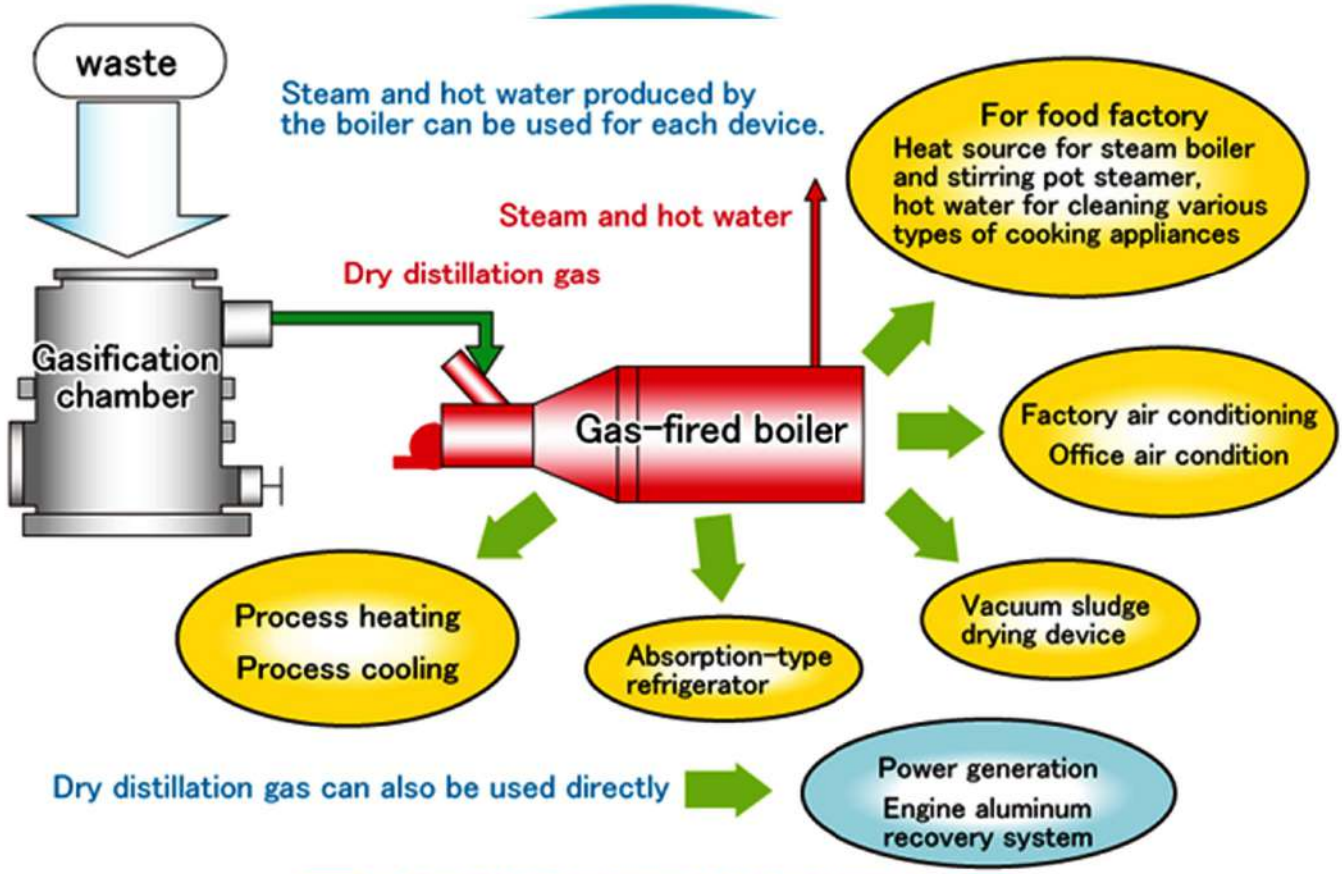
Examples of Thermal Recycling:

a **Thermal Plastic Recycling:** Heating certain plastics, such as PET, and reshaping them into new products.

b **Thermal Rubber Recycling:** Reusing old tires by reshaping them through heating for use in asphalt production or other rubber products.

c **Pyrolysis of Waste:** Heating certain wastes, such as organic and plastic waste, in the absence of oxygen to break them down into gases, liquids, and charcoal.

d **Waste Incineration for Energy Generation:** Burning waste to generate electricity or heat, reducing waste and recovering energy. However, this requires measures to reduce harmful emissions.



Chemical Analysis and Reprocessing

Definition: A process where materials are broken down into their basic components using chemical reactions, such as crushing and melting glass in special furnaces to produce new glass.

Example of Chemical Analysis: Reaction of silica (SiO_2) with hydrochloric acid (HCl) to produce silicon tetrachloride ($SiCl_4$) and water.

$$SiO_2\,(s) + 4HCl\,(aq) \longrightarrow SiCl_4(I) + 2H_2O(I)$$

Assessing Ecosystem Health

Recycling technologies help reduce the need to extract new resources, minimizing the environmental impact of mining, reducing landfill waste, and contributing to the preservation of ecosystem health and biodiversity.

Research and Investigation

Comparison of Material Recycling Techniques: Conduct comprehensive research on various techniques like magnetic separation and electrostatic separation.

Research Focus:

- Understand how each technique works and the materials it can separate.
- Examine the environmental impact of each technique, such as energy consumption, resulting waste, and gas emissions.

Comparison Table Template:

Technique	Environmental Efficiency	Advantages	Examples of Materials Separated	Disadvantages
Magnetic Separation			Ferrous metals (e.g., iron)	
Electrostatic Separation			Plastics and metals	
Density-Based Separation			Materials separable by density	
Lightweight and Heavy Material Separation			Lightweight and heavy materials	

Chapter Three

Lesson 3: Green Hydrogen as a Clean Fuel

Get Ready!!!

Imagine a future where we use an eco-friendly fuel that helps reduce climate change. In this lesson, we will explore green hydrogen as a clean and efficient fuel that could be a potential alternative to fossil fuels. We will learn how green hydrogen is produced, how it can replace conventional fuels, and its positive impact on the environment. Imagine how the world would be if green hydrogen became the primary source of energy!

Learn

- In light of increasing environmental challenges, green hydrogen is a promising clean fuel, yet its large-scale and efficient production faces difficulties.
- Organisms like bacteria and algae play an important role in this field, as they can produce hydrogen through natural biological processes. These biological methods are highly efficient and have a lower environmental impact compared to traditional methods.
- These organisms rely on light or organic materials to produce hydrogen, making them a promising option for sustainable energy. Therefore, investing in research and development in this field will contribute to achieving sustainable development goals and reducing reliance on conventional energy sources.

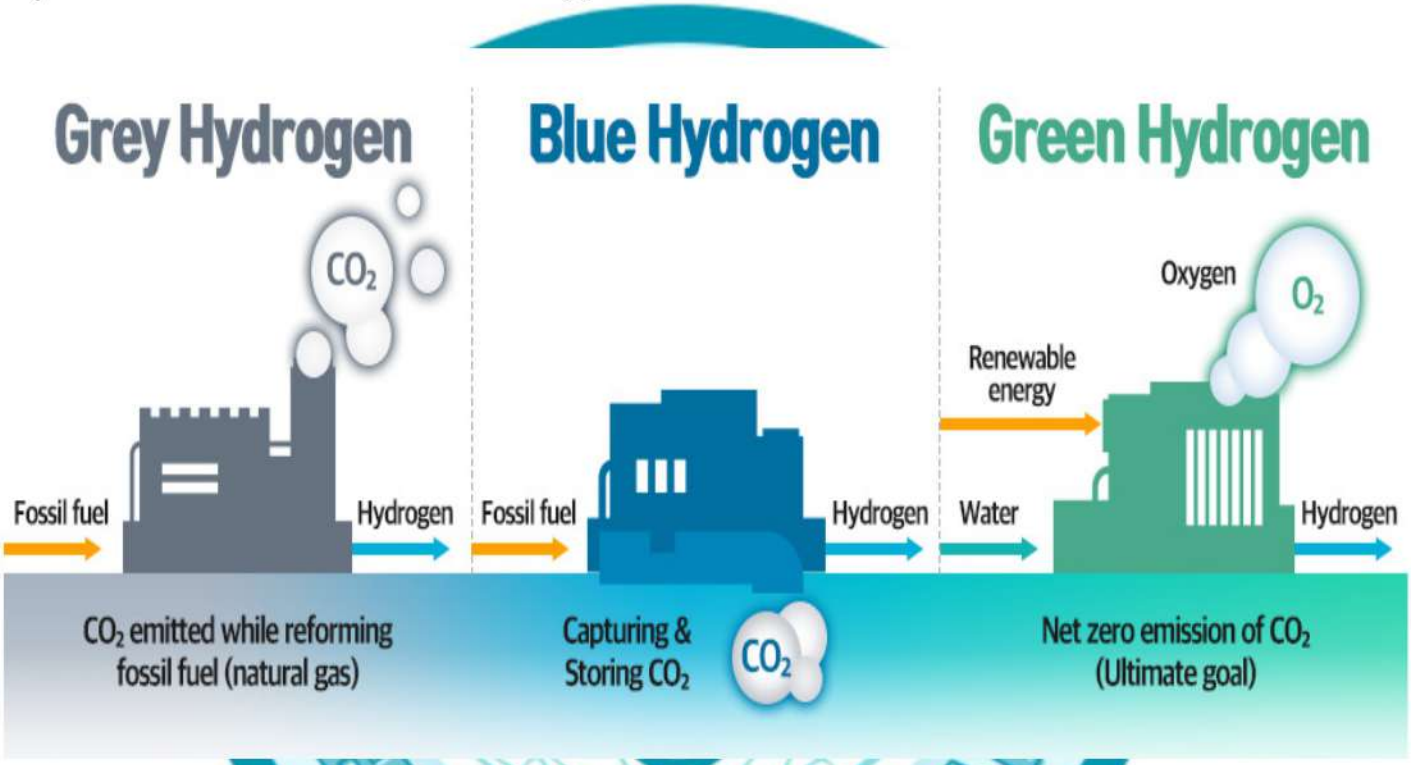
Green Hydrogen Production Process

- The efforts of governments to heavily invest in green hydrogen production face several challenges. These include high production costs, limited **renewable energy**, and **storage difficulties.**
- Progress in this field can be made by transitioning from gray and blue hydrogen to green hydrogen.
- Hydrogen itself has no true color, as it is a colorless gas, but colors are used as terms to indicate the method of its production:

  o Green Hydrogen: Considered the purest type, it is characterized by zero environmental emissions (zero carbon). It can be directly used as fuel for cars due to its high quality.

- **Blue Hydrogen:** Less pure, as it involves %10 carbon emissions, and is used in industrial activities.
- **Gray Hydrogen:** Produced using traditional methods that generate carbon emissions.

Green hydrogen remains the most expensive. This is because producing one ton of green hydrogen requires 61 megawatt-hours of renewable electricity. Therefore, to replace the currently produced gray hydrogen with green hydrogen, it would require 36,000 megawatts, which is more than 60% of Egypt's total electricity generation capacity, according to a study by the Information and Decision Support Center.



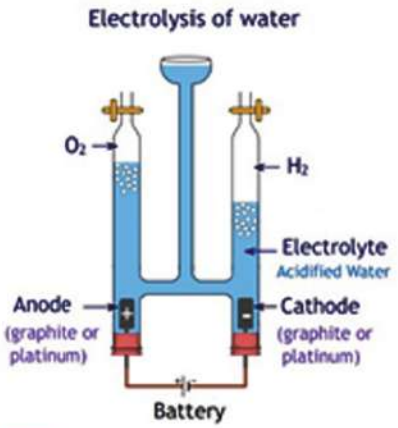
Challenges in Storing Green Hydrogen

- Renewable energy production is not the only challenge facing green hydrogen production; **there is also the challenge of storing it before consumption or transportation.** Various options exist for storing hydrogen, such as storage in salt caverns or depleted gas fields.
- **In Egypt,** depleted gas fields can be used for hydrogen storage in areas such as the Nile Delta and the Western Desert. However, there is limited information regarding the number of salt caverns used for this purpose.
- Additionally, there could be a problem with hydrogen reacting with remaining materials in depleted wells, potentially leading to the release of hydrogen sulfide gas.

Green Hydrogen Production

- Green hydrogen can be produced through the process of water electrolysis, where an electric current is passed through water to break it down into hydrogen and oxygen.

$$2H_2O \longrightarrow 2H_2 + O_2$$



- For hydrogen to be considered «green,» the electricity used in the electrolysis must be carbon-free (green electricity), meaning it is produced from renewable energy sources such as water, wind, or solar power.

Biological Methods for Hydrogen Production

- Green hydrogen can also be produced through biological methods using:

a. Bacteria: Certain types, such as Clostridium and Enterobacter, can produce hydrogen by breaking down organic materials in the absence of oxygen.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \longrightarrow \underset{\text{Lactic acid}}{CH_3COCOOH} + 4H_2 + 3CO_2$$

Hydrogen Production Mechanism

The hydrogen production mechanism by Clostridium and Enterobacter follows a series of basic steps:

1. **Primary Breakdown of Organic Materials:** Bacteria break down complex organic compounds into simpler components.
2. **Fermentation:** The simple components are converted into organic acids like formic acid and lactic acid, which are then converted into hydrogen gas and carbon dioxide.
3. **Enzymatic Reactions:** The bacteria use specific enzymes to catalyze reactions that produce hydrogen.

Factors Affecting Hydrogen Production

Hydrogen production depends on several factors, including:

1. **Temperature:** Clostridium bacteria require temperatures between 60-30 °C, while Enterobacter can grow at lower temperatures.
2. **pH:** Both bacteria require a specific pH range, often around 7-6, for efficient hydrogen production.
3. **Type of Organic Material:** Carbohydrates are the optimal material for stimulating hydrogen production, while proteins may produce unwanted gases.
4. **Algae:** Species like Chlamydomonas reinhardtii can produce hydrogen using solar energy during photosynthesis. Under certain conditions (such as sulfur deprivation), algae can convert water into hydrogen and oxygen.

- To illustrate how algae produce hydrogen during photosynthesis, we can represent this process with the following equations:

1. **Basic Water Splitting Equation:** In this process, algae split water into hydrogen gas (2H2) and oxygen gas (2O2) using solar energy.

$$2H_2O + \text{Sun light} \longrightarrow 2H_2 + O_2$$

2. **Traditional Photosynthesis (Under Normal Conditions):** Under normal conditions, algae produce oxygen through photosynthesis: Oxygen, hydrogen ions, and electrons are generated in the process.

$$2H_2O + \text{Sun light} \longrightarrow 4H^+ + O_2 + 4e^-$$

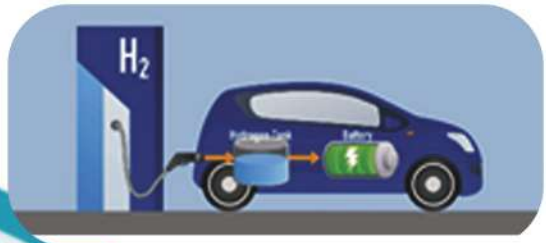
3. **Hydrogen Production Under Sulfur Deprivation:** When sulfur is deficient, algae convert electrons from water splitting to produce hydrogen instead of oxygen: In this case, the electrons and hydrogen ions generated are used directly to produce hydrogen gas.

$$4H^+ + 4e^- \longrightarrow 2H_2$$

- These equations show how algae harness solar energy to produce hydrogen, a clean and sustainable energy source.

Applications of Green Hydrogen in Clean Energy Technologies

1 Transportation



- **Hydrogen Cars:** Fuel cells convert hydrogen into electrical energy, reducing the use of fossil fuels and lowering carbon emissions.
- **Public Transport:** Many cities have started using hydrogen-powered buses, supporting the shift towards eco-friendly transportation.

2 Industry

- **Industrial Processes:** Green hydrogen can replace natural gas in various industrial processes.
- **Efficiency Improvement:** Hydrogen helps reduce carbon emissions from heavy industries, supporting environmental sustainability.

3 Air Quality Improvement

- **Pollutant Reduction:** Using green hydrogen helps decrease airborne pollutants, leading to improved air quality in cities.

Did you know?

The biological production of green hydrogen faces several challenges, including:

- Low efficiency and high costs associated with research, development, and operation.
- The need for precise environmental conditions and sustainable food sources for the organisms used.
- Challenges related to the stability of the organisms and integration with existing industrial processes.
- Despite these challenges, investing in this field is essential to achieving a sustainable energy future.

Research and Investigation: Green Hydrogen vs. Fossil Fuels

Imagine a world where cars drive, airplanes fly, and factories operate using clean energy that doesn't harm the environment. This world may not be far off, thanks to renewable energy and innovative technologies like green hydrogen.

- **Fossil Fuels: The Past and Environmental Risks**

  The world still heavily relies on fossil fuels (oil, coal, natural gas), which require complex extraction processes like drilling and mining. The major issue is that burning fossil fuels releases large amounts of carbon dioxide (CO_2) and other pollutants, contributing to climate change and air pollution.

- **Comparison Between Green Hydrogen and Fossil Fuels**
  - **Green Hydrogen:** Used to power electric cars, heavy industries, and even airplanes.
  - **Fossil Fuels:** Used in most sectors, from car engines to electricity generation.

- **Comparison Table: Fossil Fuels vs. Green Hydrogen**

Fossil Fuels	Green Hydrogen
Requires extraction and refining from underground sources.	Produced from water using renewable electricity.
Affordable energy and easy transportation.	Clean energy with zero carbon emissions.
Causes air pollution and contributes to global warming.	Reduces pollution and improves air quality.
Used in transportation, industry, electricity generation.	Used in transportation, industry, and clean energy.

Research and Investigation Questions

After filling out the table, answer the following questions based on the information you gathered:

1. What is the fundamental difference between the production processes of green hydrogen and fossil fuels?
2. What are the main environmental benefits of using green hydrogen compared to fossil fuels?
3. Why is green hydrogen considered a sustainable alternative to fossil fuels?
4. What are the major challenges facing the widespread use of green hydrogen?
5. How can green hydrogen help reduce pollution and climate change?

Chapter Four

Lesson 1: Biotechnology in Energy Development

Get Ready!!!

- Imagine you're part of a team working on developing a new energy source using biotechnology. In this lesson, you will learn how biotechnology can be used to enhance energy sources such as biomass and energy-generating microbes.
- How can these technologies contribute to the development of new and sustainable energy sources, and how do they affect energy efficiency and environmental protection? Let's begin by exploring how biotechnology transforms living organisms into innovative energy sources.

Biotechnology and the Transformation of Living Organisms into Energy Sources

Biotechnology is a scientific field that deals with using living organisms or their components to achieve specific goals. This field includes applications in medicine, agriculture, and industry, with one of the innovative applications being the use of biotechnology to transform living organisms into energy sources.

1 Bioenergy:

Bioenergy is energy derived from living organisms (plants and animals), and it is characterized by being renewable and environmentally friendly.

How living organisms are used to produce energy:

Biological Decomposition: Biological decomposition is the process of converting organic materials (such as waste) into energy using living organisms such as bacteria. This process can occur naturally or be artificially controlled in facilities that convert waste into energy. This process often produces methane gas, which can be used as an energy source.

Basic Steps of Biological Decomposition:

step 1

Hydrolysis:

In this stage, bacteria break down complex organic materials such as carbohydrates, proteins, and fats into simpler units like sugars, amino acids, and fatty acids. **For example, starch (a carbohydrate) is broken down into glucose.** $(C_6H_{10}O_5)n + H_2O \longrightarrow nC_6H_{12}O_6$

step 2

Acid Fermentation:

In this stage, acid bacteria convert the sugars and amino acids produced in the initial decomposition into short-chain fatty acids or alcohols. Gases such as carbon dioxide and hydrogen are also produced.

step 3

Acetic Acid Production :

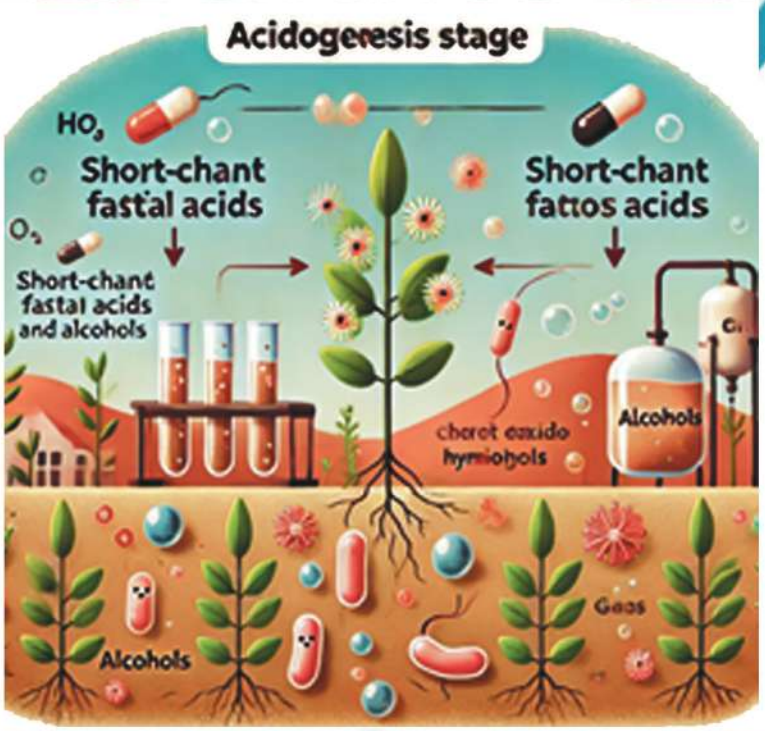
In this stage, bacteria convert the fatty acids, alcohols, or gases produced in the previous stage into acetic acid, hydrogen, and carbon dioxide.

step 4

Methane Production :

In the final stage, methanogenic bacteria convert acetic acid or carbon dioxide and hydrogen into methane gas (CH_4) and water. This is the most important stage in the production of biogas energy.

$CO_2 + 4H_2 \longrightarrow CH_4 + 2H_2O$ أو $CH_3COOH \longrightarrow CH_4 + CO_2$



2 Biofuel

- Biofuel is a type of energy source produced from living organisms such as plants or algae.
- Biofuels include ethanol and biodiesel. The chemical processes for producing biofuel:

a Bioethanol Production (Fermentation):

Bioethanol production starts with converting starchy or sugary materials into simple sugars (such as glucose) through hydrolysis. These sugars are then fermented using yeast to produce ethanol (C_2H_5OH) and carbon dioxide (CO_2).

b Biodiesel Production:

In this process, vegetable oils or animal fats (which contain triglycerides) react with alcohol (usually methanol or ethanol) in the presence of a catalyst such as sodium hydroxide .

Search:

Bioenergy is considered an important source of renewable and sustainable energy that relies on the use of renewable natural resources. What are the environmental benefits of using biofuels, and what are the main challenges in using biofuels as an alternative to fossil fuels?.

كيفية طباعة صفحات معينة من ملف معين

مثلا ازاى نطبع الصفحات من صفحة 4 الى صفحة 9